BBC
wildlife
OCTOBER
2025
Issue 11 Vol 43
discoverwildlife.com

Q&A
WHAT'S THE RAREST COLOUR IN NATURE?

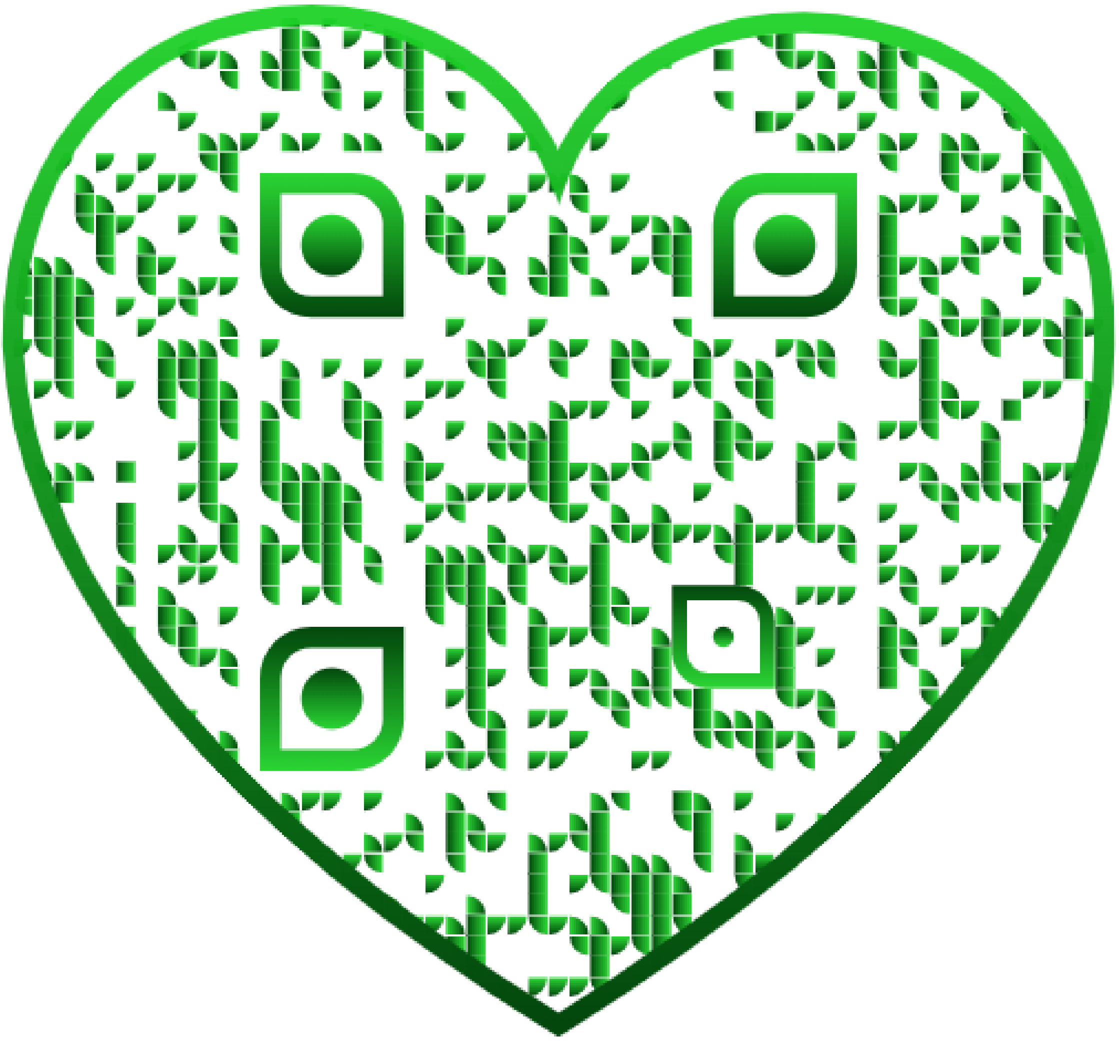
The weird 'owl gull' of the Galápagos

Who pays to rewild the planet?

Inside the secret world of wood ants

SEA OF HOPE

How First Nations are safeguarding wildlife in Canada



HURTIGRUTEN EXPEDITIONS

SAFARI AT SEA

SET SAIL THROUGH SVALBARD

Svalbard is a Norwegian archipelago situated between mainland Norway and the North Pole.

One of the world's northernmost inhabited regions, it is known for its remote and rugged terrain—an Arctic wilderness of glaciers, frozen tundra, and dramatic fjords. The region teems with wildlife: polar bears roam the ice, Svalbard reindeer graze the tundra, and Arctic foxes dart across the snow.

Surrounding waters are rich with marine life, including seals and several species of whales such as belugas and humpbacks. Birdlife is also abundant, with colonies of puffins, Arctic terns, and guillemots nesting along coastal cliffs. In winter, the Northern Lights dance across the polar sky, while summer brings the "midnight sun," with 24 hours of continuous daylight.

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ON THE BBC THIS MONTH

Mangroves in Honnavar, India

Unexpected Elements

BBC WORLD SERVICE Flooding is causing devastation around the world. In the episode *Floods, Mangroves and Rampaging Tractors,* Laura Michie from the Mangrove Action Project explains how mangrove forests can protect coastal zones.
Catch up on BBC Sounds

Doongmabulla Springs

Life at 50°C

BBC NEWS *The Battle of Doongmabulla Springs*, a new feature film from the BBC World Service's *Life at 50°C* series, follows an Aboriginal family's fight to stop a Queensland coal mine that could damage this sacred site and crucial water source for local fauna.
Catch up on iPlayer

Rare Earth

BBC RADIO 4 Environmental journalist Tom Heap and physicist Helen Czerski explore the world of animals that provoke fear and wonder in equal measure. In the episode *Creatures of the Night* they celebrate the wildlife that works while we sleep.
Catch up on BBC Sounds

MANGROVES: AMITH NAG PHOTOGRAPHY/GETTY; DOONGMABULLA SPRINGS: R KEEGAN-TRELOAR/FLINDERS UNIVERSITY; TOTEM POLE: KEITH LEVIT/FIRST LIGHT/ALAMY

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Totem pole in British Columbia, Canada

I'm trying to think more like Indigenous people

PAUL McGUINNESS, EDITOR

One of the great pleasures of my job is meeting extraordinary people who work with wildlife in all corners of the world. But few have made such an impression on me as the First Nations people I met in British Columbia earlier this year (*p52*). I found their connection to nature so refreshing.

Many of Canada's Indigenous people have origin stories of how their tribe came from wolves, clams or crows (among others), while in the present they explained to me how they consider the next seven generations in all of their actions that affect the lands they have stewarded for some 14,000 years.

This 'past, present and future' way of thinking about the natural world is so healthy, for both humans and wildlife. I also found it inspirational in terms of perspective of my place in time and space. At times it's good to feel so small.

Paul

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BBC Wildlife (ISSN 0265-3656 USPS XXXXX) is published monthly with an extra copy in spring by Our Media Ltd, Eagle House, Bristol, BS1 4ST, United Kingdom. Airfreight and mailing in the USA by World Container Inc, c/o BBT 150-15 183rd St, Jamaica, NY 11413-4037, USA. Periodicals postage paid at Brooklyn, NY 11256.

POSTMASTER: Send address changes to *BBC Wildlife*, World Container Inc, c/o BBT 150-15, 183rd St, Jamaica, NY 11431, USA.

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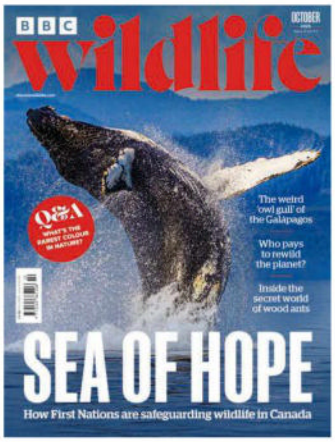

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SEA OF HOPE
How First Nations are safeguarding wildlife in Canada

THE COVER

This month's cover star is a humpback whale, photographed by Rolf Hicker near north-east Vancouver Island in the traditional territories of the Kwak'wala-speaking peoples. *See p52*

Inside a wood ant colony

HUMPBACK WHALE: ROLF HICKER; RED WOOD ANT: INGO ARNDT; JAY: MIKE WILKES/NATUREPL.COM; SWALLOW-TAILED GULL: TUI DE ROY; WOLVERINE: ARNDT SVEN-ERIK/ARTERRA PICTURE LIBRARY/ALAMY

Every month, only in *BBC Wildlife*

NICK BAKER
"A desman is a peculiar type of mole that has turned its weird credentials into a life in water." ***p36***

KATE BRADBURY
"There's something about seeing a bat that makes you shout 'bat!' It's the only way to greet one." ***p27***

MIKE DILGER
"Observers regularly record the migrations of 300,000 raptors and 150,000 white and black storks." ***p32***

DAVID LINDO
"It can be tough being a fox, and in the urban jungle it really is a case of survival of the fittest." ***p29***

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Colourful jays come out of hiding, foraging for fallen acorns to stock their winter larders
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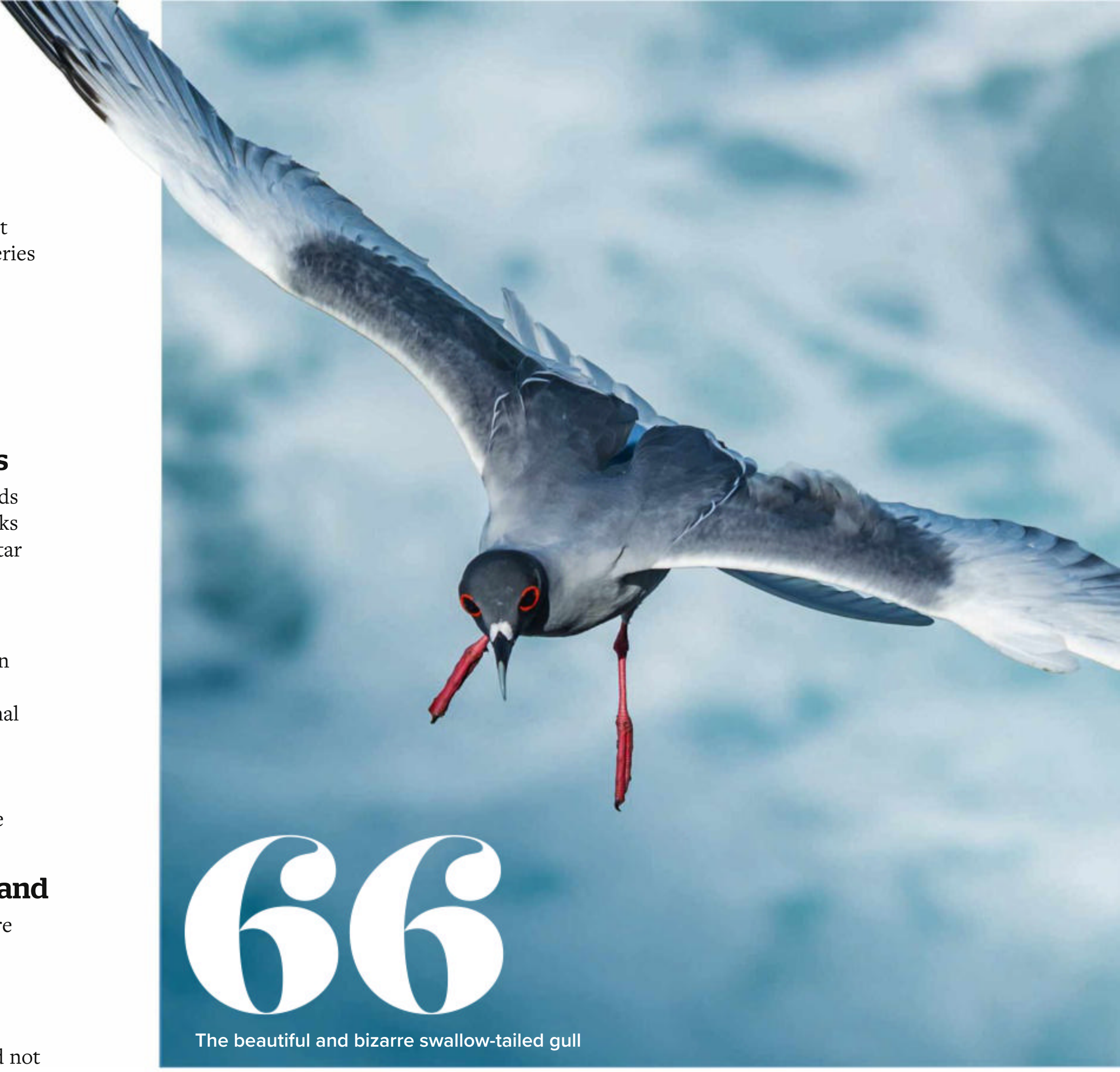
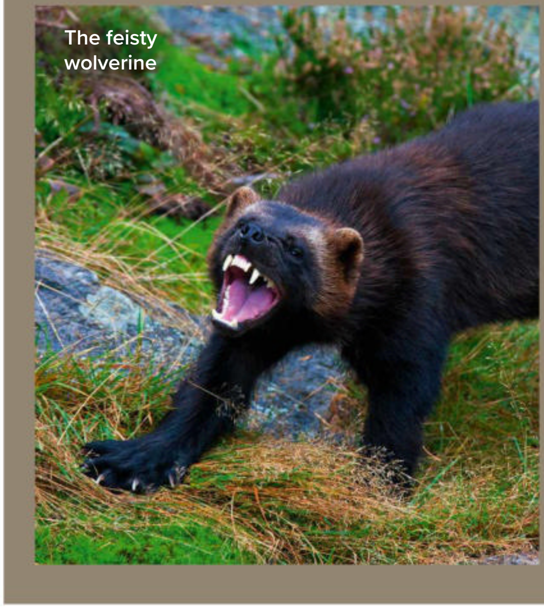


The beautiful and bizarre swallow-tailed gull

Discover MORE



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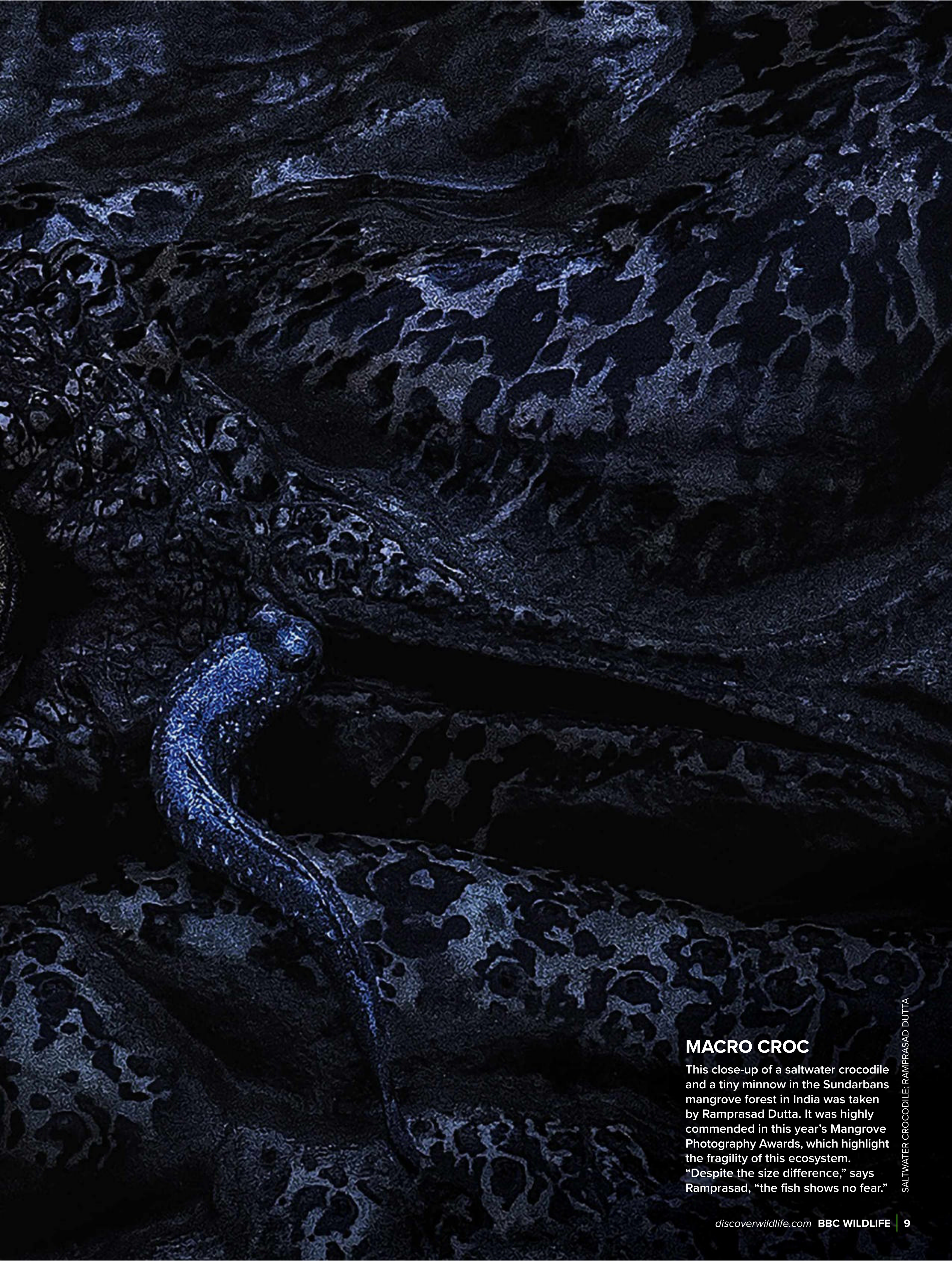
wild TIMES

The latest news, photography and seasonal wildlife highlights



SALTWATER CROCODILE: RAMPRASAD DUTTA

MACRO CROC

This close-up of a saltwater crocodile and a tiny minnow in the Sundarbans mangrove forest in India was taken by Ramprasad Dutta. It was highly commended in this year's Mangrove Photography Awards, which highlight the fragility of this ecosystem. "Despite the size difference," says Ramprasad, "the fish shows no fear."

Great apes ‘scrump’ for boozy fruit

Dietary habits of ancient great apes help to explain why humans are so good at metabolising alcohol

SCIENCE MAY FINALLY have discovered why us humans are so good at drinking booze. A new study, published in the journal *BioScience*, suggests that we owe our ability to metabolise alcohol to our great ape ancestors’ penchant for feasting on fallen, fermented fruit.

It’s known that humans and other African great apes, such as gorillas and chimps, have a mutation in a gene, called alcohol dehydrogenase 4 (ADH4), that makes them good at breaking down alcohol. Compared with orangutans and other primates that lack the mutation, they are 40 times better at metabolising booze.

Genetic studies have shown that this mutation was present in the last common ancestor of African apes, which lived around 6 million years ago, prompting researchers to wonder if African apes – past and present – ingest alcohol in the form of fallen, fermented fruits.

Scrabbling around for a term to describe the behaviour, the researchers, from the University of St Andrews and Dartmouth College, drew a blank. “Nobody wants more jargon,” they wrote in their paper, “but sometimes we need a new word to capture a fundamental concept.” So, they settled on ‘scrumping,’ an English derivation of the Middle Low German word *schrimpen*, meaning ‘shrivelled’, and a medieval noun that describes over-ripe fruit.

While searching for the right term, they discovered many examples of gothic art that show primates eating fallen fruit, including one carved into the base of a pillar on Chartres Cathedral.

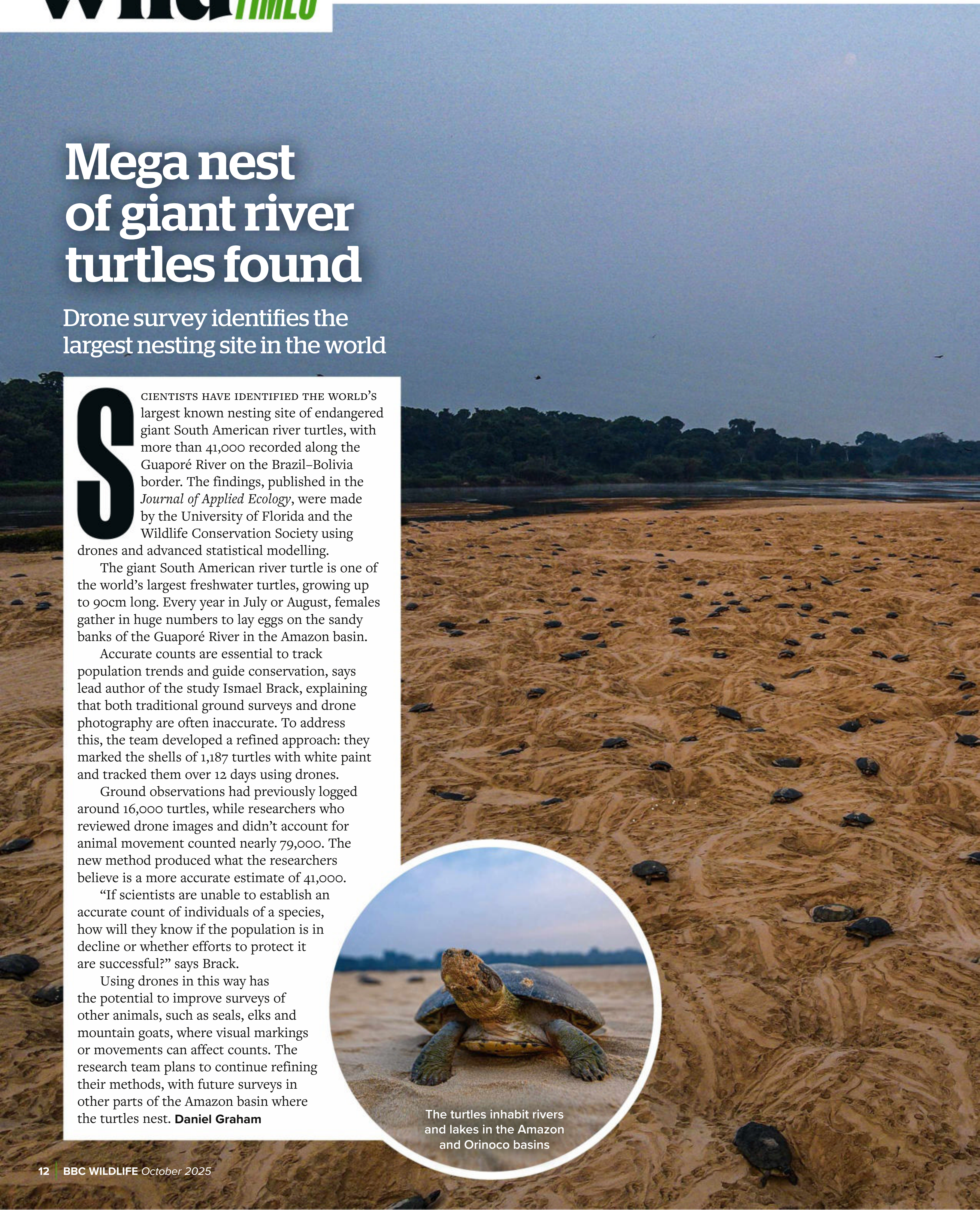
Spurred on, they delved into their behavioural database to assess what proportion of fruits, consumed by great apes, are handpicked from the trees versus scrumped from the ground. Mountain gorillas, western gorillas and chimpanzees scrumped between a quarter and two-thirds of their fruits, while orangutans, which do not carry the alcohol-metabolising gene variant, scrumped less than 1 per cent.

So, the hypothesis that emerges is that ancient African apes scrumped alcohol-laced fruit because it was calorie dense, meant they didn’t have to use energy climbing trees, and because their genetics enabled them to handle it. Fast-forward to the present day and, though we may not scrump for fallen fruits likes chimps, we do drink cider.

As Catherine Hobaiter, one of the lead authors of the study says, “One upshot is that sharing a cold pint of scrumpy this summer echoes a behaviour our ape ancestors might have already been partaking in 10 million years ago.” **Helen Pilcher**

Chimps eat 300 different items, including fruits, berries, leaves and seeds

CHIMPANZEE: ERIC BACCEGA/NATUREPL.COM



Mega nest of giant river turtles found

Drone survey identifies the largest nesting site in the world

Scientists have identified the world's largest known nesting site of endangered giant South American river turtles, with more than 41,000 recorded along the Guaporé River on the Brazil–Bolivia border. The findings, published in the *Journal of Applied Ecology*, were made by the University of Florida and the Wildlife Conservation Society using drones and advanced statistical modelling.

The giant South American river turtle is one of the world's largest freshwater turtles, growing up to 90cm long. Every year in July or August, females gather in huge numbers to lay eggs on the sandy banks of the Guaporé River in the Amazon basin.

Accurate counts are essential to track population trends and guide conservation, says lead author of the study Ismael Brack, explaining that both traditional ground surveys and drone photography are often inaccurate. To address this, the team developed a refined approach: they marked the shells of 1,187 turtles with white paint and tracked them over 12 days using drones.

Ground observations had previously logged around 16,000 turtles, while researchers who reviewed drone images and didn't account for animal movement counted nearly 79,000. The new method produced what the researchers believe is a more accurate estimate of 41,000.

"If scientists are unable to establish an accurate count of individuals of a species, how will they know if the population is in decline or whether efforts to protect it are successful?" says Brack.

Using drones in this way has the potential to improve surveys of other animals, such as seals, elks and mountain goats, where visual markings or movements can affect counts. The research team plans to continue refining their methods, with future surveys in other parts of the Amazon basin where the turtles nest. **Daniel Graham**

The turtles inhabit rivers and lakes in the Amazon and Orinoco basins

Females dig holes and deposit 80–200 eggs on nesting beaches on sandy islands amid rivers

Dolphins tend to swallow their prey whole, digesting it in several stomachs

Up close with dolphins

Meet some of the ocean's smartest swimmers

It's one of wildlife's most mesmerising spectacles, in which predators unite to hunt dense, swirling shoals of fish known as baitballs. Now, a new National Geographic film, *Dolphins Up Close With Bertie Gregory*, gives viewers an intimate look at this rare natural phenomenon. Film-maker Bertie Gregory heads to the Azores, an archipelago in the Atlantic Ocean, to capture the display. The volcanic islands are surrounded by Europe's largest marine protected area, making these waters a vital habitat for migrating predators. Gregory also meets an ex-whaler turned whale spotter and discovers how the end of whaling allowed marine life to return to Azorean waters. The film is available on Disney+ from 19 September. **Sophie Ellis**

TURTLE CLOSE-UP AND NESTING BEACH: OMAR TORRICO; DOLPHINS: BERTIE GREGORY/NATIONAL GEOGRAPHIC

The study of the anteaters' behaviour took place in the Brazilian Cerrado

MIGHTY TAILS

Giant anteaters have a total of 11 separate functions for their tails, according to a new study. Researchers from the Wild Animal Conservation Institute found that, as well as obvious uses such as balance, the mammals use their tails to shade themselves, to hide from predators and to transport pups.

The Namib Desert beetle is impressively speedy for its size

Cool runners of the desert

The beetle that beats the heat by sprinting

THE NAMIB DESERT BEETLE RUNS AS fast as possible to cool itself down in the blistering heat. Reported in the *Journal of Experimental Biology*, this is the first non-flying animal known to use exercise to cool off.

In their relentless search for food and mates, male Namib Desert beetles spend their days travelling across the dunes of the Namib Desert on the south-west coast of Africa, occasionally taking breaks in rare patches of shade. When moving over the 50°C sand, these tiny, flightless beetles sprint at speeds of 1m/s using long legs that lift their disc-shaped bodies about 15mm above the ground, where the air is 10–15°C cooler thanks to wind from the Atlantic.

To carry out the study, researchers took the temperatures of both living and dead beetles. They then released the live beetles back onto the dunes and placed the dead beetles 15mm above the sand in the sun. Next, they compared the live beetles' body temperature 30 seconds into a sprint with that of the stationary insects. Despite having been exercising under intense solar radiation, the sprinting beetles were, on average, 1.5°C cooler than their dead counterparts. The researchers discovered that convection was behind this cooling effect, with heat from the insects' bodies transferring to the colder surrounding air.

The scientists think that Namib Desert beetles are probably not alone in using convection to cool off. "A unique strategy has come to light," says Meredith Johnson from North Dakota State University, who took part in the research. "It defies conventional understanding that exercise adds heat to the body." **Sophie Berdugo**

GIANT ANTEATER: NICK GARBUTT/NATUREPL.COM; NAMIB DESERT BEETLE: JOH HENSCHEL

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THE EXPERTS

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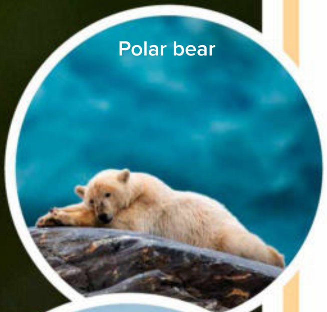
Follow in the footsteps of famous travellers on an expedition cruise to the Galápagos Islands. This archipelago off the coast of Ecuador was visited by Charles Darwin during his voyage around the world in the early 1800s. And no wonder – this collection of islands is a biodiversity hotspot, filled with an array of fascinating endemic animals and plants. On an expedition cruise with HX, you'll have the chance to see giant tortoises, marine iguanas, American flamingos and more.

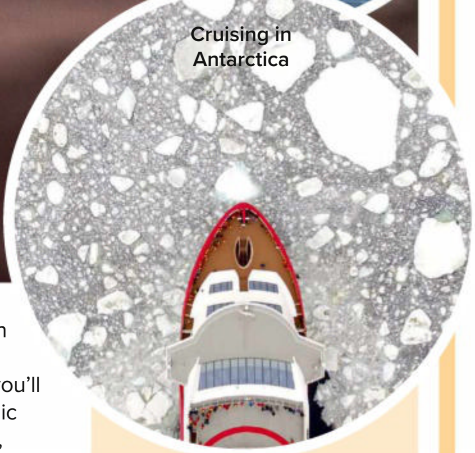
Galápagos Islands

Exploring on a smaller expedition boat

American flamingos


Polar bear

Walrus


Cruising in Antarctica

A visit to the Charles Darwin Research Station is another highlight, with its giant tortoise breeding centre and guided tours. Get closer with additional excursions, such as kayaking, snorkelling and visiting remote coves on a smaller expedition boat. The onboard Expedition Team will teach you about conservation and explain the efforts that are being made to preserve this precious place.

THE FROZEN CONTINENT
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The burning question on moors

We go inside the debate on grouse shooting and the perceived benefits of burning heather

To understand why there is continued acrimony over our uplands, with the illegal killing of raptors, such as hen harriers, still a major point of contention, you have to realise this is not just – or even mainly – about birds. Birds of prey, waders and even songbirds are all collateral damage (or, in some cases, winners) in a much bigger conflict about what these areas – the Yorkshire Dales, the North York Moors, the Peak District and others – should look like.

It's about areas of deep peat called blanket bogs, for which the UK is the most important country in the world, and which store vast quantities of carbon. It's about what makes these uplands special, how we keep them that way and who pays for it. The people who own these moors say that they love the moors. They want to see wildlife – including birds of prey – thriving, and they say that grouse shooting is the best way to do that.

> "In order to have sufficient numbers of grouse for shooting, you have to effectively farm them, which you do partly by burning heather"

In order to have sufficient numbers of grouse for shooting, you have to effectively farm them, and you do that partly by burning heather. Adult grouse feed on fresh, tender heather shoots, and the best way to get the plant to rejuvenate is to burn it. Moor owners argue that burning heather both increases biodiversity and helps to store carbon, and there is plenty of science to back this up.

For example, one long-running and ongoing study by scientists at the University

Red grouse populations are declining, perhaps due to diseases and the loss of heather moorland

of York looked at three management options for peat-dominated moorlands, and found that both burning and cutting were effective ways to increase sphagnum moss cover, along with shrubs and sedges.

"The burned plots had the highest species richness and diversity from around two years after management," said the scientists in a report called *Protecting Our Peatlands*, which was published in 2023.

Indeed, argues Andrew Gilruth, chief executive of the Moorland Association, a diversity of habitats is exactly what you want. "You're looking for a mosaic of different heights of heather," he says. "In one area, you want fresh shoots, and in others you want cover for the grouse to escape from birds of prey. They do not benefit from a monoculture."

A gamekeeper burns heather in the North Pennines, County Durham

Grouse shooters about to begin hunting

"Grouse moor owners don't necessarily make a lot of money out of shooting"

Another necessary action is to control predators such as foxes and crows, which would otherwise take grouse chicks. This has the knock-on benefit of allowing other ground-breeding birds to thrive. Research also shows that curlews and golden plovers, for example, achieve the highest rates of reproduction on grouse moors. The other thing to remember is that, while grouse moor owners are undoubtedly wealthy, they don't necessarily make a lot of money out of shooting.

"For a lot of landowners, grouse shooting as a business model is marginal," says Nick Hesford, Scotland director for the Game & Wildlife Conservation Trust. While there are many benefits for local economies in terms of jobs and spending, grouse moor owners themselves are not making money out of grouse shooting, he argues.

WILDLIFE CONSERVATIONISTS DISPUTE many of the grouse moor owners' arguments in favour of the field sport. They rightly point out that the position of organisations such as the government's wildlife advisor Natural England and the IUCN UK Peatland Programme is that burning has negative impacts. The latter's 'position statement' on burning is that it results in "damage to peatland species, micro topography and wider peatland habitat." It concludes, "Healthy peatlands do not require burning for their maintenance."

Conservationists' biggest complaint is that, in order to maximise the number of grouse, gamekeepers have to illegally kill birds of prey. Birds such as hen harriers, peregrine falcons and golden eagles are all targets because they take grouse and their chicks, and this can have a substantial impact on how many are available by the time the Glorious Twelfth – the first day of shooting in August – comes around.

The RSPB says there are up to 110 confirmed incidents involving the illegal killing of protected raptors every year. Bob Elliot, who previously worked as its head

WHAT IS BLANKET BOG?

- Blanket bog is usually found in upland areas (at altitudes of up to 1,000m) where there is plenty of rain, poor drainage and acidic conditions.
- Plants found in a blanket bog include sphagnum mosses, cotton grasses, heathers and dwarf shrubs such as bilberry and crowberry.
- Peat accumulates as the mosses and cotton grasses die but do not decompose – instead they become layers of peat, which can accumulate to depths of 5m or more.
- Peat can be up to 6,000 years old, and the UK has 15 per cent of all the world's blanket bogs.

RED GROUSE: MARK CAUNT/ALAMY; BURNING HEATHER: DAVID FORSTER/ALAMY; GROUSE SHOOTERS: REBECCA COLE/ALAMY

According to the RSPB, record numbers of hen harriers have been killed or gone missing over the past five years

HEN HARRIER: MARK HAMBLIN/2020VISION/NATUREPL.COM

"Any landowner in Scotland wanting to shoot grouse now requires a licence"

of investigations and now runs the lobby group Wild Justice, says it happens all the time. "They need to find a way of managing their land without killing birds of prey and committing wildlife crimes," he says. Staff at the RSPB's Geltsdale reserve in Cumbria, he says, have had to supplementary feed two hen harrier nests this year because the males have gone missing. The chances are they strayed from the reserve onto neighbouring shooting estates and were killed, he adds.

Tom Aspinall, the RSPB's senior uplands policy officer, argues that even the fact that waders do well on grouse moors is a mirage. "You might get good curlew and golden plover numbers, but you don't get a lot of other Red List birds because grouse moors are simplified landscapes," he says. "Our Eastern Moors reserve [a former grouse moor] has a lot of birds that don't get much press, such as tree pipits and redpolls, and that are associated with more mixed habitats."

And this is perhaps where we get to the nub of the issue. Conservationists say they want to see a more varied habitat on our uplands than grouse moor owners. A great swathe of purple-blooming heather might look fabulous in July and August, but it's just a monoculture to someone trying to increase the diversity of birds and plants.

So can the issue be resolved? The first thing to note is that the biggest change in a generation has taken place in Scotland in the past year. Any landowner wanting to shoot grouse now requires a licence to do so, and any evidence of illegal activity – killing of birds of prey, for example – could result in that licence being taken away.

THE RSPB SUPPORTS THIS MOVE AND would like to see it introduced in England and Wales. "I don't think it's unreasonable to think grouse shooting should be regulated across the whole of the UK in a similar fashion," says Aspinall. Shooting in Europe and the USA is regulated, he points out.

Grouse moor interests are less positive about the benefits of licensing. Andrew Gilruth says more regulation will deter owners from managing the land properly. "Anyone who thinks it's in the interests of raptors to no longer have gamekeepers working in the hills, just wait and see," he warns. "In the Republic of Ireland, the golden eagle population is collapsing because no one is managing the land and the prey base has gone."

There is no indication the government will introduce a licence system, but there is one change in the offing. The Department for Environment, Food & Rural Affairs (Defra) carried out a consultation earlier this year that, if its recommendations were adopted, would increase the area of peat in England and Wales on which landowners are not allowed to burn by more than 1,000km^2.

Again, this is supported by groups such as the RSPB and largely opposed by moor owners, who also say that reducing burning will increase the fuel load on the moors, leading to more wildfire outbreaks, which are already reaching dangerous levels.

Gilruth says the problem with the conservationists' position is they don't have an idea of what the end point is. "If you want to replace one thing with another, you have to ask yourself what's wrong with what we've got and why, and whether your solution is sustainable in the long-term."

Is heather burning unsustainable? Is predator control that benefits other breeding birds wrong? And if not, is there really a problem – persecution of birds of prey aside – with grouse shooting?

ABOUT THE AUTHOR

James Fair is a wildlife journalist with a specialism in conservation and controversial issues. Read more at jamesfairwildlife.co.uk.

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7 nature encounters for the month ahead

WITH NATURALIST AND AUTHOR BEN HOARE

1

Food-storing birds such as jays use spatial memory to find previously cached food items

Planters of forests

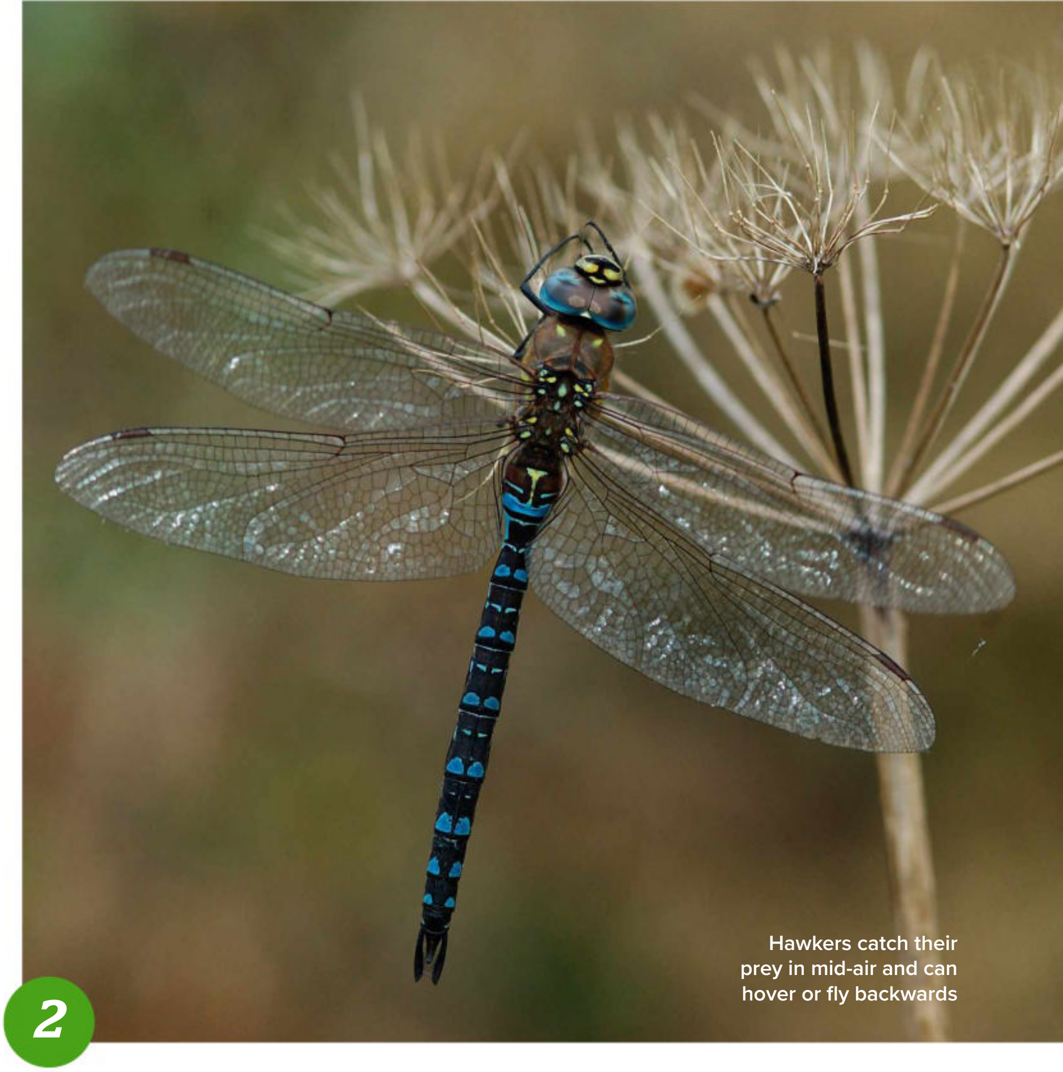
JAYS ARE SECRETIVE BIRDS, at least by crow standards. They have a knack of slipping away among trees unseen, or we might glimpse their bright white rumps as they vanish into the leaves, shrieking as they go. In October, this all changes, as the birds are emboldened by their search for fallen nuts, especially acorns. Each jay will hide thousands of acorns to eat over the coming winter – inadvertently helping to plant the forests of the future.

2

Here be dragons

Some dragonflies wander a long way from the freshwater habitats where they first emerged, having undergone a dramatic metamorphosis from their ferociously predatory aquatic larval stage. Migrant hawkers, as their name suggests, are among these great travellers. In sunny weather you can often see them hunting flies and midges up and down hedgerows or the edges of wooded areas, sometimes in impressive swarms.

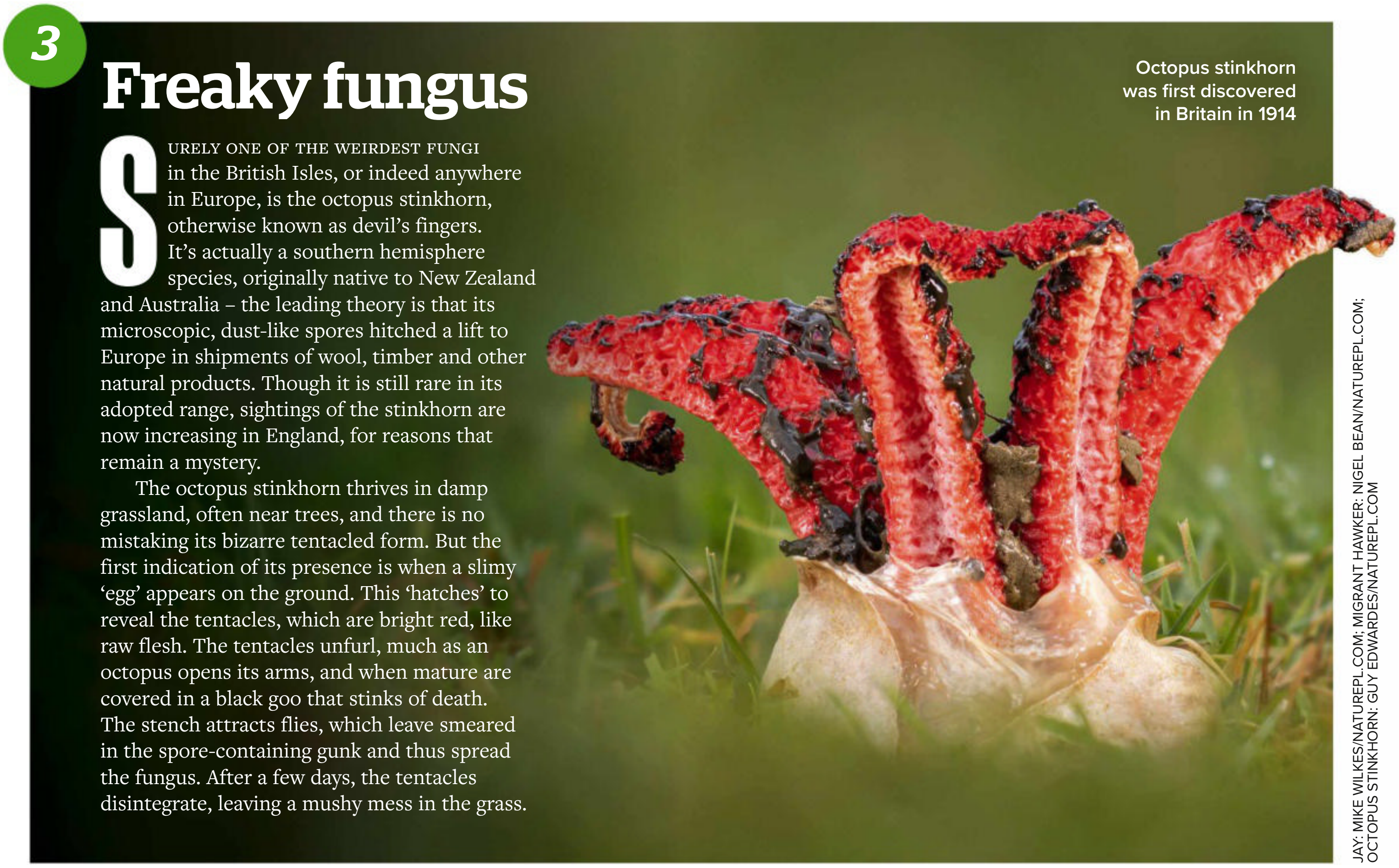
There should still be plenty of these large dragonflies around in England, Wales and the island of Ireland in October and well into November. They have also recently colonised southern Scotland, one of many insect species moving north in response to climate change. Males are spotted blue and yellow, with huge blue eyes, while females are brownish with yellow spots and brown eyes. Like other dragonflies, they have a phenomenal success rate of up to 95 per cent when hunting, perhaps the highest of any predator on Earth.



Hawkers catch their prey in mid-air and can hover or fly backwards

3

Freaky fungus



Octopus stinkhorn was first discovered in Britain in 1914

Surely one of the weirdest fungi in the British Isles, or indeed anywhere in Europe, is the octopus stinkhorn, otherwise known as devil's fingers. It's actually a southern hemisphere species, originally native to New Zealand and Australia – the leading theory is that its microscopic, dust-like spores hitched a lift to Europe in shipments of wool, timber and other natural products. Though it is still rare in its adopted range, sightings of the stinkhorn are now increasing in England, for reasons that remain a mystery.

The octopus stinkhorn thrives in damp grassland, often near trees, and there is no mistaking its bizarre tentacled form. But the first indication of its presence is when a slimy 'egg' appears on the ground. This 'hatches' to reveal the tentacles, which are bright red, like raw flesh. The tentacles unfurl, much as an octopus opens its arms, and when mature are covered in a black goo that stinks of death. The stench attracts flies, which leave smeared in the spore-containing gunk and thus spread the fungus. After a few days, the tentacles disintegrate, leaving a mushy mess in the grass.

JAY: MIKE WILKES/NATUREPL.COM; MIGRANT HAWKER: NIGEL BEAN/NATUREPL.COM; OCTOPUS STINKHORN: GUY EDWARDES/NATUREPL.COM

Crab apple trees can live for up to 100 years. Their gnarled appearance may have influenced their common name

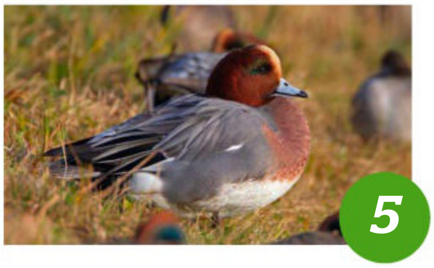
Ancient apple

Apple Day on 21 October is an ideal moment to celebrate our overlooked native apple tree. The crab apple is today best known as a small garden tree that bears attractive but small fruit, whose firm flesh and sharp taste suits jams and jellies rather than eating on the spot. However, the true wild crab apple still survives in parts of the country. It's probably among the least-known of all Britain's trees – look out for its twisted shape and thorny twigs, hiding in traditionally managed hedgerows or woods, or long forgotten in the corner of old meadows.

The apples are eaten by birds such as this fieldfare

ABOUT THE AUTHOR

Ben Hoare is a wildlife writer, editor and all-round nature nerd. He also writes highly acclaimed illustrated natural history books for children.

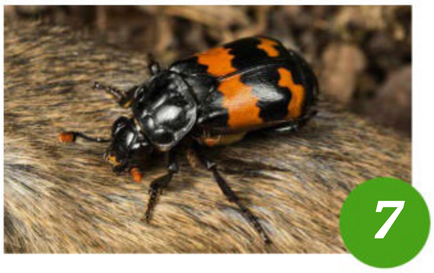


Name that tune

We get so used to hearing mallard quacks that the more tuneful calls some other ducks make can be a surprise. Eiders produce a throaty croon, for example, while teals and wigeons whistle. From October until March, the drake wigeon's two-note *whee-ooo* is one of the most joyful wetland sounds.

Odd one out

Most of Britain's crickets and grasshoppers are plant-munchers. In contrast, oak bush-crickets are decidedly carnivorous and live high in the foliage of trees. The strikingly green insects are active at night and are often attracted to lit windows in autumn.



Clean-up crew

Small mammals and birds raise far more young than will ever survive, which in autumn inevitably leads to a glut of dead bodies. Sexton beetles are soon on the scene, often arriving at fresh carcasses within hours. They immediately begin burying the carcasses as food for their larvae.

CRAB APPLES: LAURIE CAMPBELL/NATUREPL.COM; FIELDFARE: COLIN VARNDELL/NATUREPL.COM; MALE WIGEON: ERNIE JANES/ALAMY; OAK BUSH-CRICKET: ANDY SANDS/NATUREPL.COM; SEXTON BEETLE: CHRIS MATTISON/NATUREPL.COM

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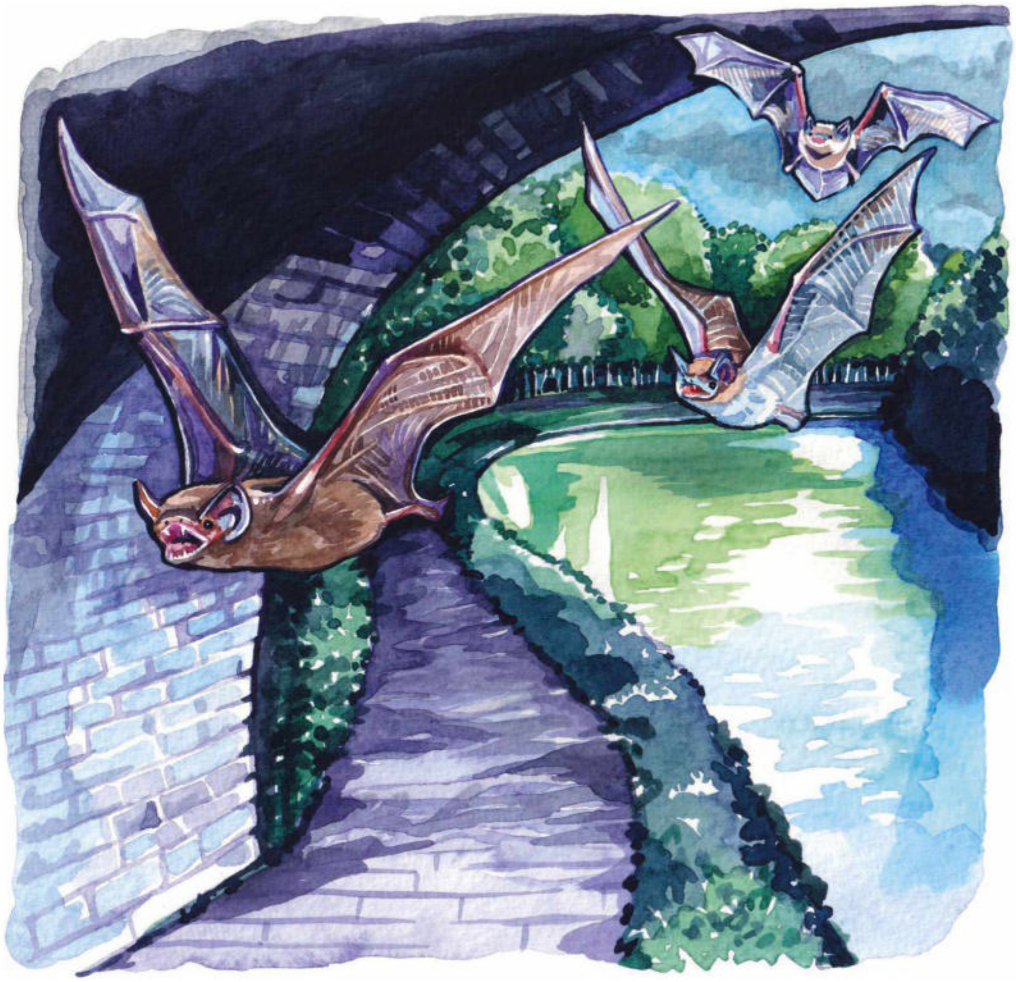

NOTES ON NATURE

KATE BRADBURY

As the nights draw in, encountering bats can be a magical adventure

THERE'S SOMETHING ABOUT seeing a bat that makes you shout “bat!” It's the only way to greet one – on summer nights around the campfire, waiting for the first to start flitting around the treetops, or in autumn, as the nights draw in, and you see them at teatime. “Bat!” you say to whoever you're with, or the dog, or yourself. “Bat!”

I love bats. In the UK we have 18 species, though only 17 are known to be breeding (the 18th is the greater mouse-eared bat, of which there are only two known individuals in the UK). When I lived in London I'd often take part in bat surveys along the Thames in Richmond, walking along a street-lit section of the towpath and then an unlit section, to study the effects of light pollution on foraging behaviour.

Working in pairs, members of the group would set bat detectors to a certain frequency so we could record the echolocations of a specific species. The lit section always had more common pipistrelles, which have adapted to eating the moths and other insects that gather around streetlamps, but the darker sections were where the more exciting bats were, including the noctule, Leisler's and serotine. I liked being on noctule duty best, because its echolocation ‘shouts’ resembled a loud *clip-clop* through the bat detector.

When I moved to Sussex I helped an ecologist conduct bat surveys at people's homes. While most of these were related to planning permission (all bat species are protected by both national and European legislation, so surveys of or near known roosts are required prior to building work), some were for homeowners who just wanted to know how their bats were doing. I loved these particular surveys, and I'd stand in gardens counting bats as they emerged from holes in roofs, thinking how lucky both homeowners and bats were.

On one such survey, I was recording bats in a small wooded area. A brown long-eared bat – known for the ghost-like whisper its echolocation shouts make through the bat detector – caught a mosquito hovering just in front of my face. Experiencing that in the woods, in the dark, surrounded by ghostly sounds was a magical but terrifying adventure that I'll never forget.

And yet, most legends about bats focus on the terrifying over the magical. All over the world, bats are associated with darkness and death, Halloween and vampires, their liminal bodies seen as half-animal, half-bird, and thought to be able to cross from here into the underworld.

Then there are actual vampire bats, which add to the mammals' mysterious and not-to-be-trusted nature. Native to the Americas, they don't actually suck blood, rather lap it up from open wounds, usually from livestock. In recent times, of course, bats have been blamed for Covid.

Yet bats play a significant role in ecosystems around the world. In the tropics, some plants rely on bats for pollination or seed dispersal, while others – including all British species – feed on insects, helping to keep populations under control. The 2017 State of the UK's Bats report suggests populations of many bat species are stabilising or even increasing, reflecting decades of full protection. But as insect eaters they remain vulnerable to biodiversity loss, while climate change adds further pressure, potentially pushing them out of suitable habitats.

This autumn, don't be too keen to shut the curtains on the dark, and keep an eye out for bats feeding up on insects before entering hibernation. And, of course, make sure you greet them properly, with a reminder of their name: “Bat!”

Kate is a wildlife gardening expert and author. Her latest book is *One Garden Against the World* (Bloomsbury).

ILLUSTRATION BY HOLLY EXLEY

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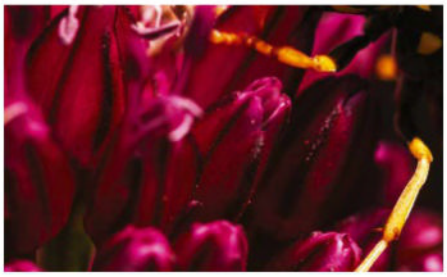

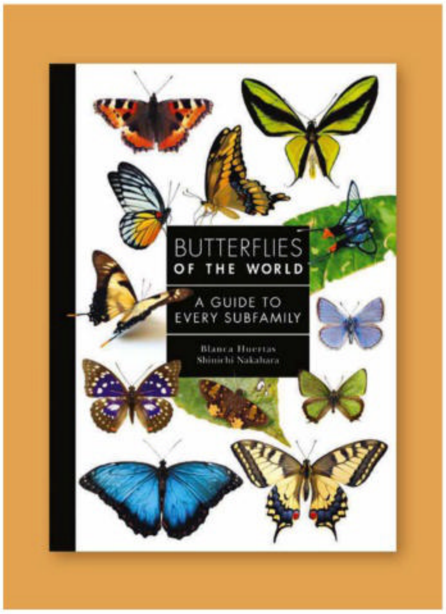
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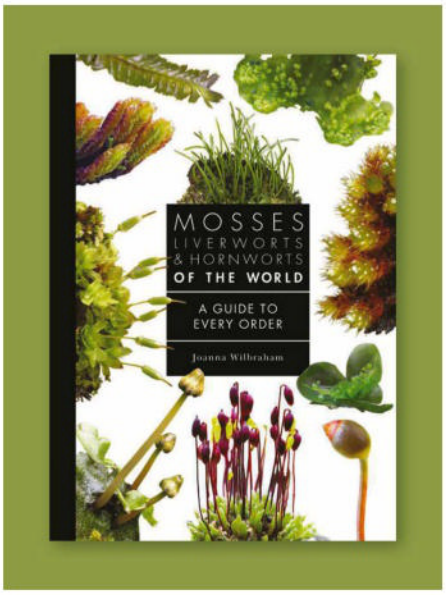
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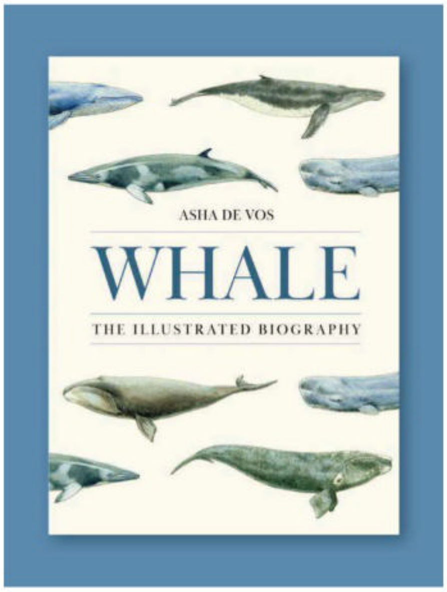
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WILD IN THE CITY

— WITH DAVID LINDO —

The British urban fox is particularly prevalent in Bristol, but metropolitan life is not as cushy as it may seem

A young red fox out and about in Bristol. Foxes will happily eat anything from fruit to frogs, and also scavenge in bins for scraps

THE WILY FOX MUST be one of the best-known animals in the UK. I am willing to place a wager that there must be less than 100 people in the country who have never heard of a fox before. I conducted a quick straw poll among some of my friends asking who had never seen a fox, and the result was a resounding zero. Everybody had seen a fox.

They go through your bins, scrounge discarded chips, lounge on lawns and garden furniture, are sometimes found squished on the road, or follow you, bold as brass, as you head home feeling slightly squiffy after a night out. These were just some of the comments I received during my completely unscientific survey. Night-time is the right time for foxes. When they are checking out the nightlife from your garage roof there is no one around to tell them to get off.

Much has been written about the good old urban fox, ranging from nursery rhymes to the tabloid press, which regale us with tales of aggressive, oversized foxes terrorising neighbourhoods. The more well-informed among us will know that you are many times more likely to be bitten by next door's Jack Russell than be troubled by a wayward fox, despite being common and often quite brazen. It is true to say that, as with many of the animals that share our city lives, foxes have been the victims of hype and exaggeration.

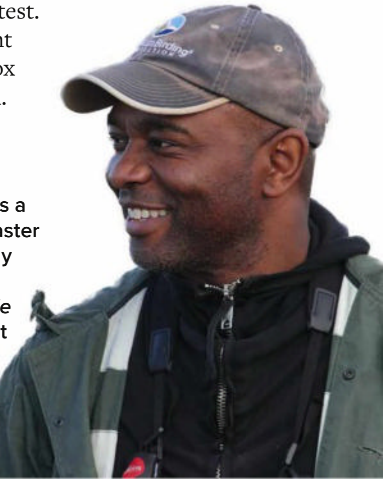
The red fox, as it is officially known, is a fascinating creature. It is the largest true fox in the world and, after us humans, is considered to be the most widely distributed land mammal on the planet. It is found throughout the northern hemisphere, including North America, plus it has been detrimentally introduced to Australia, where it has created havoc with the native species. In fact, the red fox is listed as one of the world's 100 most invasive species.

In many parts of their range, foxes are not always red, sometimes appearing brownish or even grey. Normally, they are animals occupying a wide range of habitats. Though not necessarily rummaging through bins, they have become suburban creatures in many cities around the globe. But nowhere are they more in-your-face-urban than in the UK, and particularly Bristol.

Our British foxes first developed a taste for city life as recently as the 1930s, when they initially invaded Bristol, with London following during the 1940s. It is estimated that these secretive animals are present in 90 per cent of the urban areas of England and Wales. Foxes have been a subject for study in Bristol for decades. It was here that researchers first noted how very successful they were at taking advantage of the opportunities that humans have put their way, as they are consummate omnivores.

City living certainly has its benefits – but there are downsides. Foxes are prolific breeders. In the autumn, fox families begin to split up, with the young vixens and dogs wandering off to set up new territories. Around 55 per cent of foxes die within their first year and 80 per cent don't live to see their third birthday. Many fall victim to road collisions, starvation and predation from dogs.

It can be tough being a fox, and in the urban jungle it really is a case of survival of the fittest. So spare a thought the next time a fox crosses your path. I always do.



David Lindo, AKA the Urban Birder, is a naturalist, broadcaster and author of many books, including *Fly: A Child's Guide to Birds* (Magic Cat Publishing)

RED FOX: SAM HOBSON/ALAMY; DAVID LINDO: ASHLEY BOONE

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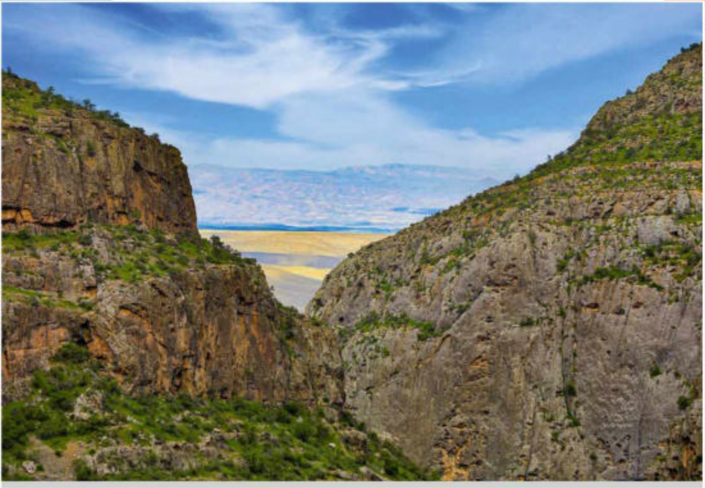

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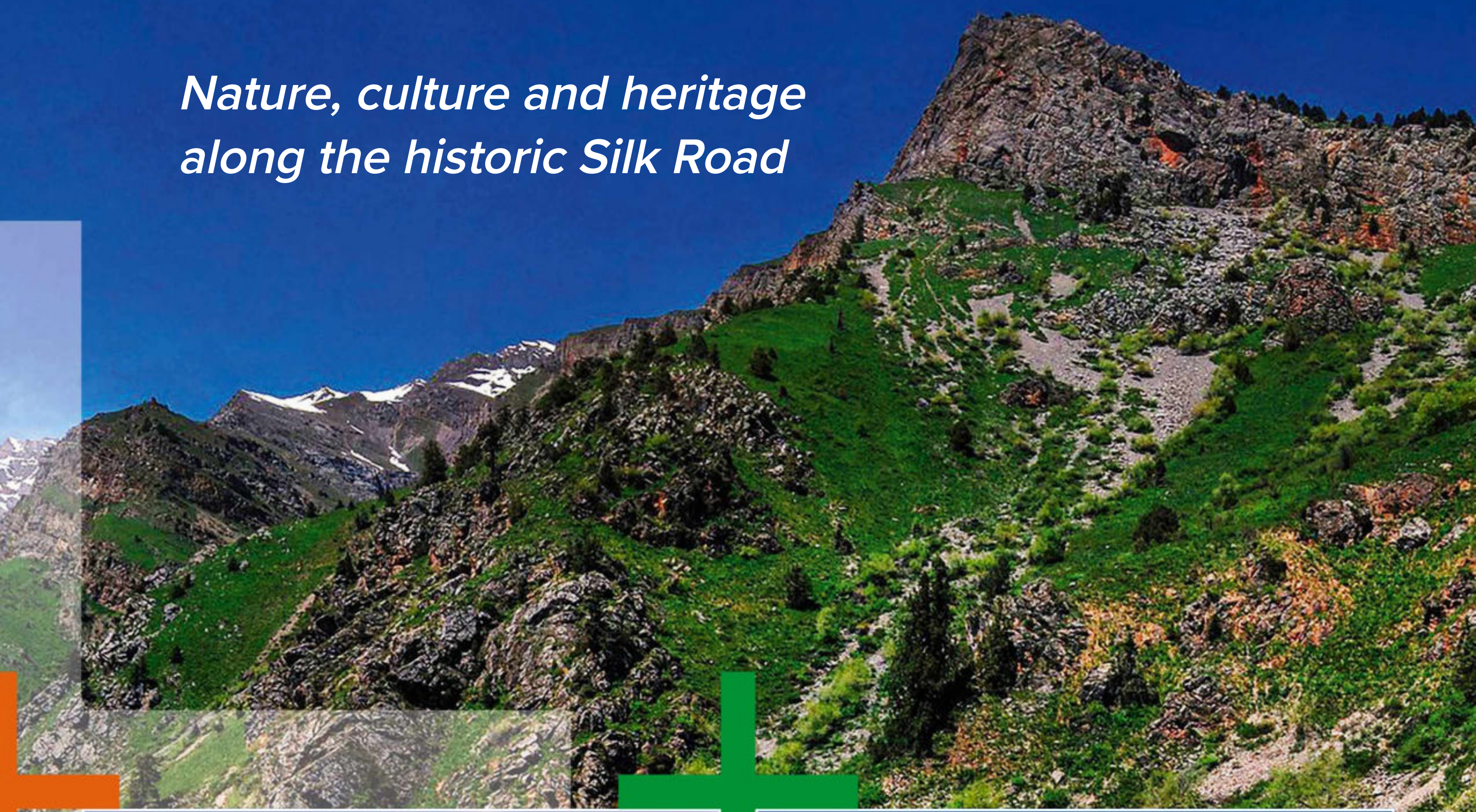

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KEEP AN EYE ON THE SKY

AVIAN MIGRATION

Raptors and storks are prize species to spot as thousands of birds take to the skies above the Strait of Gibraltar

No self-professed bird-lover should ever tire of 'vismigging', or watching avian migrations in action. This biannual event occurs when huge numbers of migratory birds follow established flyways to their breeding areas in spring, before returning along the same routes later in the year to overwinter. Catching this fabulous phenomenon can be absolutely thrilling – especially when the travellers in question are large species such as storks and birds of prey.

Egyptian vulture

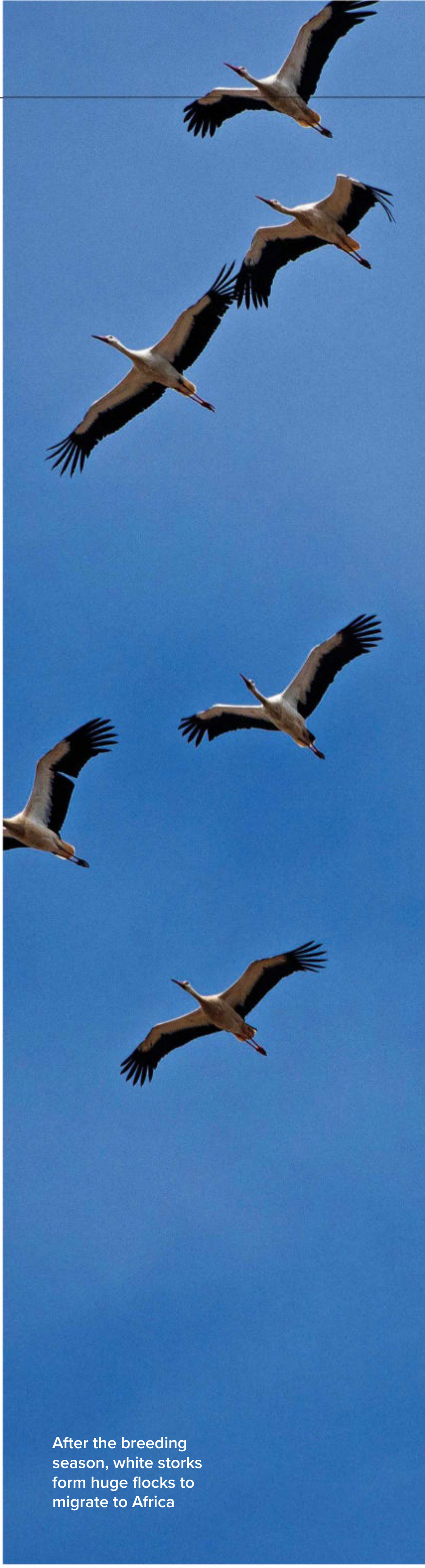
Did you know?

The Egyptian vulture, with its easily identifiable bright yellow face and white plumage, is Europe's only long-distance migratory vulture, and is also its smallest. Sadly, it is on the IUCN Endangered list.

There are three main flyways, or superhighways in the sky, around the globe. Birds move between North and South America along the Americas flyway; the East Asia and Australasia flyway stretches from Alaska to Russia's Taimyr Peninsula in the north, and to Australia and New Zealand in the south; while the African-Eurasian flyway is the route of choice between Africa and Europe or West Asia.

While all these flyways span a broad front, bottlenecks may occur where birds seek ways to avoid lengthy sea journeys. All migration is physically demanding, but ocean flights are harder for birds.

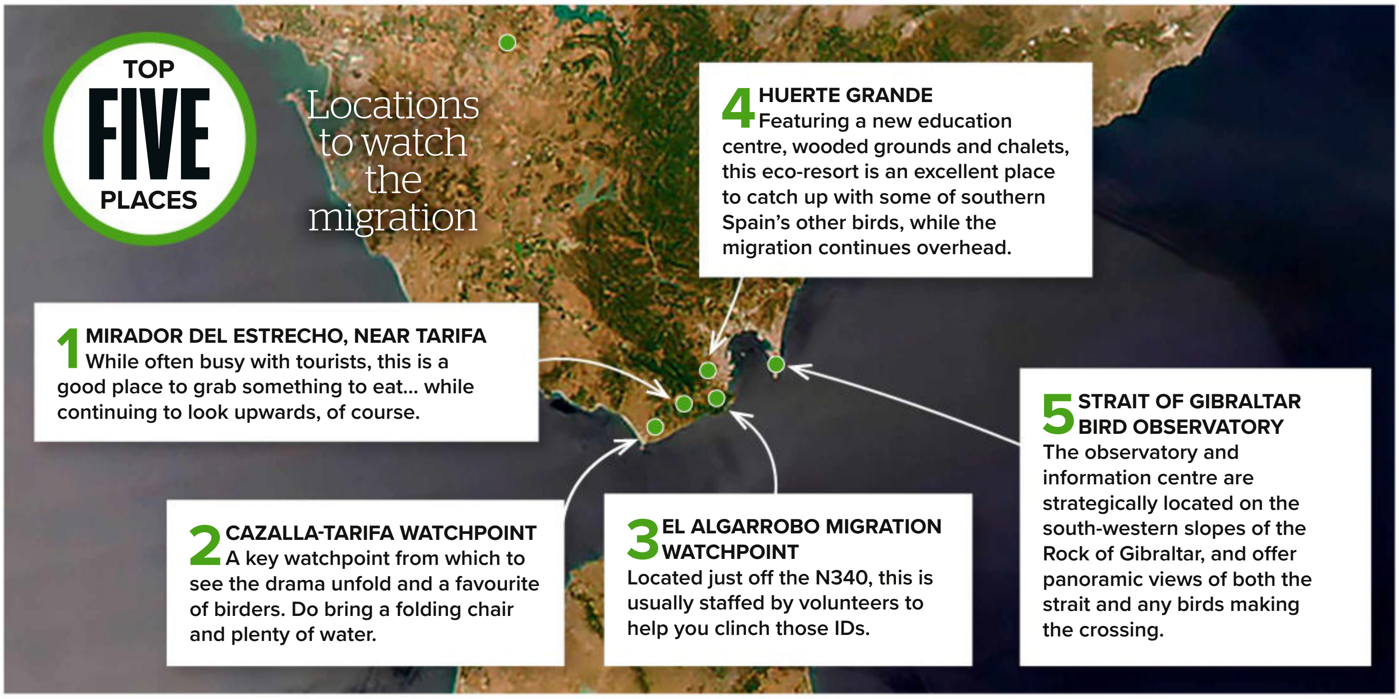
Over land, those species with large wing surfaces, such as raptors and storks, save considerable energy by soaring and gliding. This flying technique takes advantage of



After the breeding season, white storks form huge flocks to migrate to Africa

WHITE STORKS: GEORGE RESZETER/ALAMY; EGYPTIAN VULTURE: ALFONSO ROBERTO APICELLA/ALAMY

“Observers regularly record the migrations of 300,000 raptors, not to mention 150,000 storks”



TOP FIVE PLACES

Locations to watch the migration

1 MIRADOR DEL ESTRECHO, NEAR TARIFA While often busy with tourists, this is a good place to grab something to eat… while continuing to look upwards, of course.

2 CAZALLA-TARIFA WATCHPOINT A key watchpoint from which to see the drama unfold and a favourite of birders. Do bring a folding chair and plenty of water.

3 EL ALGARROBO MIGRATION WATCHPOINT Located just off the N340, this is usually staffed by volunteers to help you clinch those IDs.

4 HUERTE GRANDE Featuring a new education centre, wooded grounds and chalets, this eco-resort is an excellent place to catch up with some of southern Spain's other birds, while the migration continues overhead.

5 STRAIT OF GIBRALTAR BIRD OBSERVATORY The observatory and information centre are strategically located on the south-western slopes of the Rock of Gibraltar, and offer panoramic views of both the strait and any birds making the crossing.

a combination of updraughts (created by the land's varied topography) and thermals (upwellings of warm air produced when the sun heats the Earth's surface).

Once the birds reach the sea, though, these invisible elevators disappear. Which means, according to migration expert Simon Tonkin, that "obstacles such as mountain ranges serve as little more than speed bumps, while large stretches of open water operate like kryptonite". As a result, many birds seek the shortest possible crossing over the sea.

At just 14km wide at its narrowest, the Strait of Gibraltar is the favoured crossing point between European and African landmasses. Countless species fly over the channel, which divides Spain from Morocco, including a plethora of raptors. Indeed, Gibraltar is one of the top five places in the world to encounter birds of prey on passage.

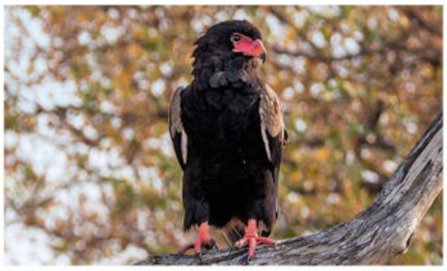
The variety and number of birds moving south for the autumn passage can be staggering. Between August and October, observers along the strait regularly record the migrations of 300,000 raptors, as well as 150,000 white and black storks. Of 28 raptor species, black kites are the most abundant, but there are high numbers of honey buzzards, short-toed eagles and Bonelli's eagles.

Picking out the less numerous raptors tests your identification skills. These include griffon and Egyptian vultures, sparrowhawks and Montague's harriers. And for any rarity seekers, successfully identifying a Rüppell's vulture or greater spotted eagle should provide a thrill.

> "Many birds seek the shortest possible crossing over the sea"

Choosing precisely when and where to watch is a fine art, requiring a combination of experience and luck. The strait is prone to both westerly and easterly winds. If the winds are too strong the birds are reluctant to make the crossing, so amass on the Spanish side while waiting for conditions to improve. During helpful conditions, the birds appear to fly higher, but when the wind is blowing from an unfavourable direction they stay at lower altitudes, with the largest crossings often occurring after several days of strong winds. The best times for mass movements tend to be mid to late morning and mid to late afternoon.

Should you wish to take a break from craning your neck upwards, look lower down to enjoy the performance of the supporting cast. You'll see colourful clouds of bee-eaters and different species of swifts slicing through the air, as they too prepare to head south for a winter break after the rigours of the breeding season.



The migratory short-toed eagle, seen here in Namibia, winters across central Africa

LOOK CLOSER

Nocturnal crossings

While smaller birds (or passerines) will also traverse the sea, many do so under cover of darkness. This enables them to avoid the twin dangers of predation and dehydration. At night, the air structure also tends to be smoother, creating better conditions for sustained and stable flight.

Out on the water

A boat trip into the strait is a great way to get up-close to a number of cetacean species, such as common, bottlenose and striped dolphins, while long-finned pilot and fin whales can also be present. On the bird front, look for Cory's, Scopoli's and Balearic shearwaters.

Striped dolphin

Europe's only primate

No one is quite sure how Barbary macaques, native to the Atlas and Rif Mountains of Morocco and Algeria, arrived in Gibraltar. These 230–240 individuals have become so habituated to humans they're best enjoyed from a safe distance to avoid any unfortunate interactions.

NEXT MONTH

The thousands of turtles that go from sea to sand in Costa Rica

MAP: WORLDSPEC/NASA/ALAMY; SHORT-TOED EAGLE: MARTIN LINDSAY/ALAMY; STRIPED DOLPHIN: ANTHONY PIERCE/ALAMY; OLIVE RIDLEY SEA TURTLE: SOLVIN ZANKL/NATUREPL.COM

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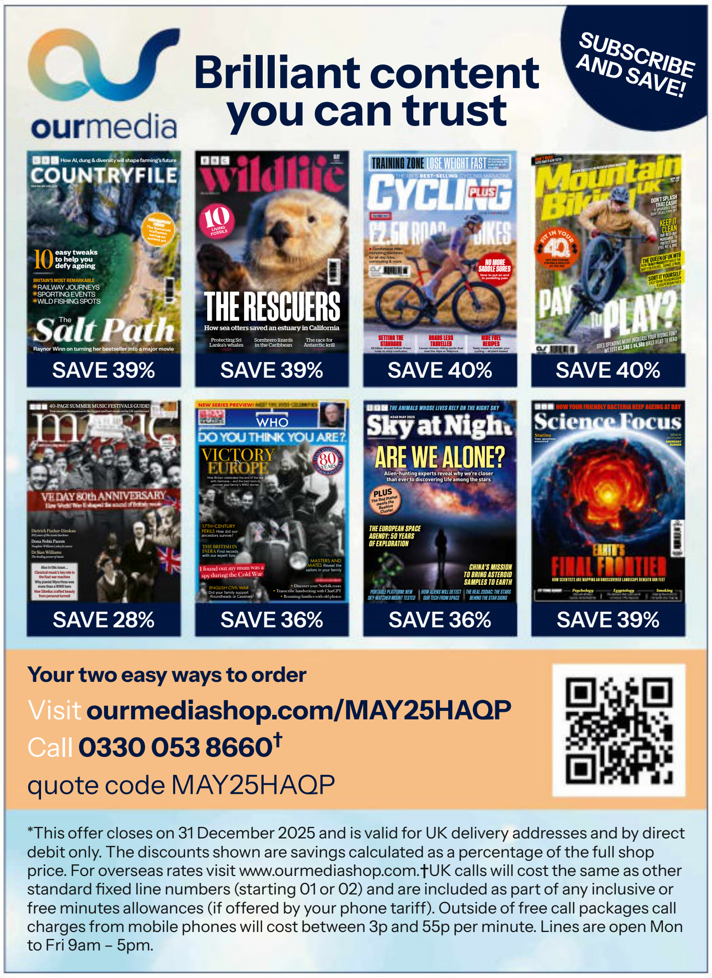

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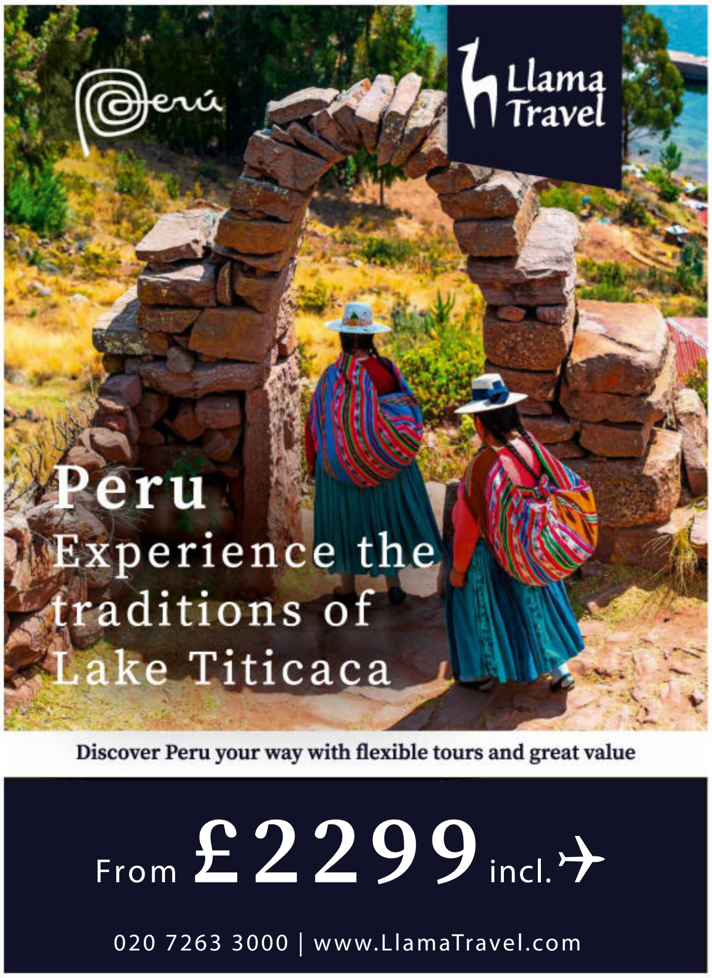

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HIDDEN WORLD

The popular naturalist, author and TV presenter reveals a secret realm of overlooked wildlife

DOWN BY THE WATER

PYRENEAN DESMAN

The secretive swimming mammal whose snout is its superpower

Moles are strange. They have evolved to become so highly specialised and attuned to a particular way of life that they are, for the most part, out of sight. Underground, they live in a fossorial world of near-total darkness in ways that are almost impossible for us surface-dwellers to imagine. If it weren't for the occasional spoil heaps thrown up from below, most of us wouldn't even register their existence.

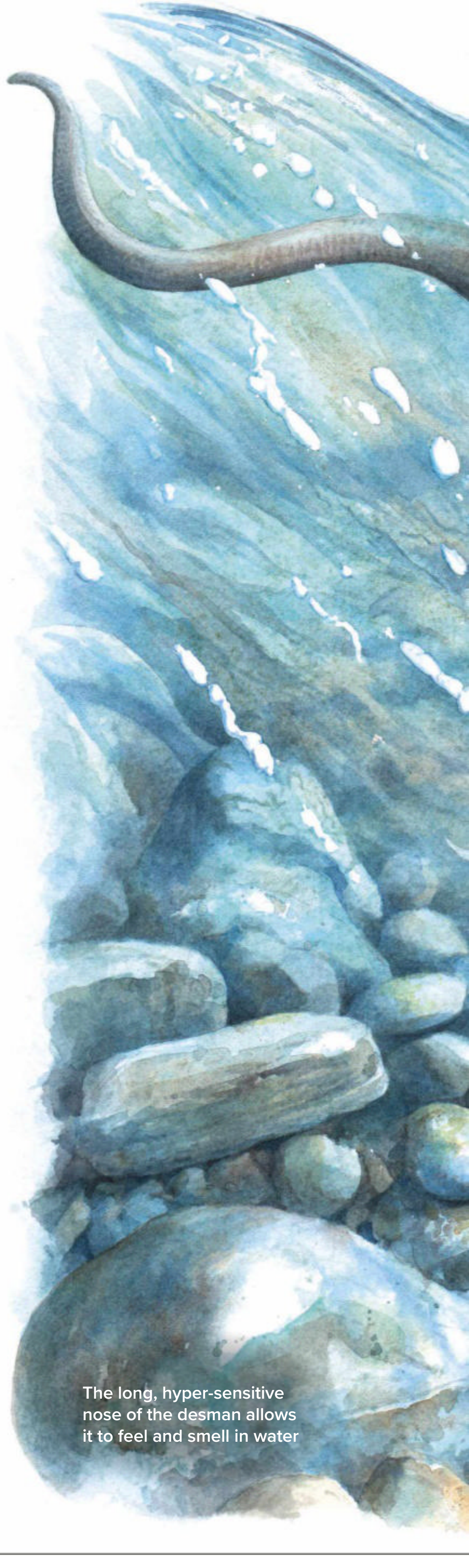
Now imagine an even more peculiar type of mole, one that has turned its already weird credentials to a life in water. This is precisely what a desman is. The Pyrenean desman (*Galemys pyrenaicus*) is one of two similar species, the other being the Russian desman. Both are rheophilic specialists – dwelling in high-energy, fast-flowing, gravel-bedded mountain streams.

At first sight, the desman looks a bit like a chunky shrew. With a bodylength of 14cm, it's about the same size as a mole (though that comparison doesn't help much, given how rarely we glimpse moles), and the tail extends it by a further 16cm. The desman's close affinities to 'mole-kind' (Talpidae) are further apparent with its dumpy body, lack of external ears, barely discernible eyes buried in grey-brown fur, and robust and powerful limbs.

The limbs are in reverse size-order to those of a mole and are just one of the adaptations to a life aquatic that start to make this animal stand out from the crowd. The rear legs are longer and more heavily muscled, equipped with clawed toes fringed with stiff hairs and with webbing in between. These are the desman's main 'thrusters': powerful paddles that propel it through the water, while the long, slightly keeled tail makes for a stabilising rudder.

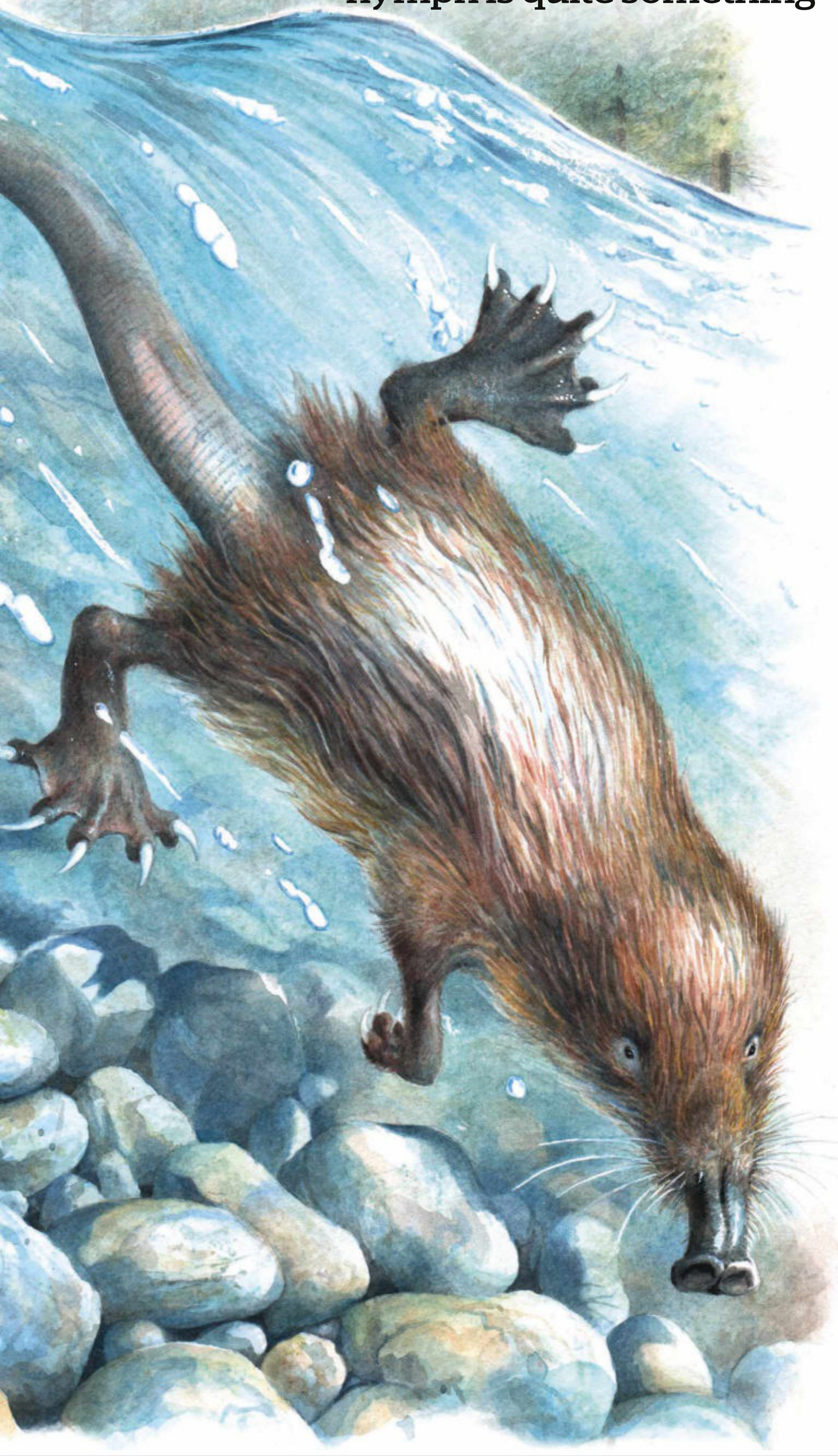
The more delicate forelimbs are chiefly used for the manipulation of prey, in conjunction with the desman's most outstanding feature: its nose. Slender, incredibly muscular and surprisingly flexible, the nose terminates at a slightly bifurcated tip and two prominent nostrils. All this gives the animal its alternative (and brilliant) colloquial name of trumpet rat.

That nose is the most peculiar thing to see in action. The desman catches prey on the stream bed – primarily aquatic insects, crustaceans, worms and small molluscs –



The long, hyper-sensitive nose of the desman allows it to feel and smell in water

“Watching a desman dispatch a large stonefly nymph is quite something”

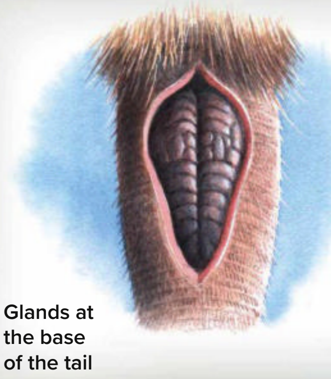


and brings it to the surface to consume. Its nose is almost prehensile, bending and prodding in conjunction with the front limbs to manipulate a meal. Watching a desman dispatch and dismember a large stonefly nymph is quite something.

But there is much more to this ‘trompe’ than just being an extra limb. Look closely and you’ll see it bristling with hyper-sensitive, stiff whiskers known as vibrissae. Many are tiny, sandwiched between minuscule papillae that give the skin a distinctive texture when viewed under a microscope. These structures are Eimer’s organs – specialised touch receptors found only in moles. If you still doubt this animal’s kinship to its subterranean cousin, this should close the deal. A desman, though, takes things a step further: it has thousands more of these receptors on the tip of its snout, making it a super somatosensory organ that effectively replaces the rest of the animal’s face.

Sensitive to touch, vibration and smell, the snout does the job of eyes, ears and tastebuds, allowing the desman to find its way around underwater and locate prey from considerable distances. Evidence shows that desmans not only ‘feel’ their prey but smell it too, by rapidly blowing out and re-inhaling air bubbles four times a second while swimming. This underwater sniffing allows the transfer of scent particles from the water to the Jacobson’s organ – a highly sensitive collection of cells at the base of the nasal passage. A desman’s nose really is its secret weapon. Ⓦ

LOOK CLOSER



Glands at the base of the tail

Scent feature

The name desman comes from the Swedish *desmanratta*, which has roots in the word for musk or pleasant scent. *Desmanratta* translates as muskrat – referring not to the North American mammal but to the glands at the base of a desman’s tail, which emit a scent for communication and territory-marking.

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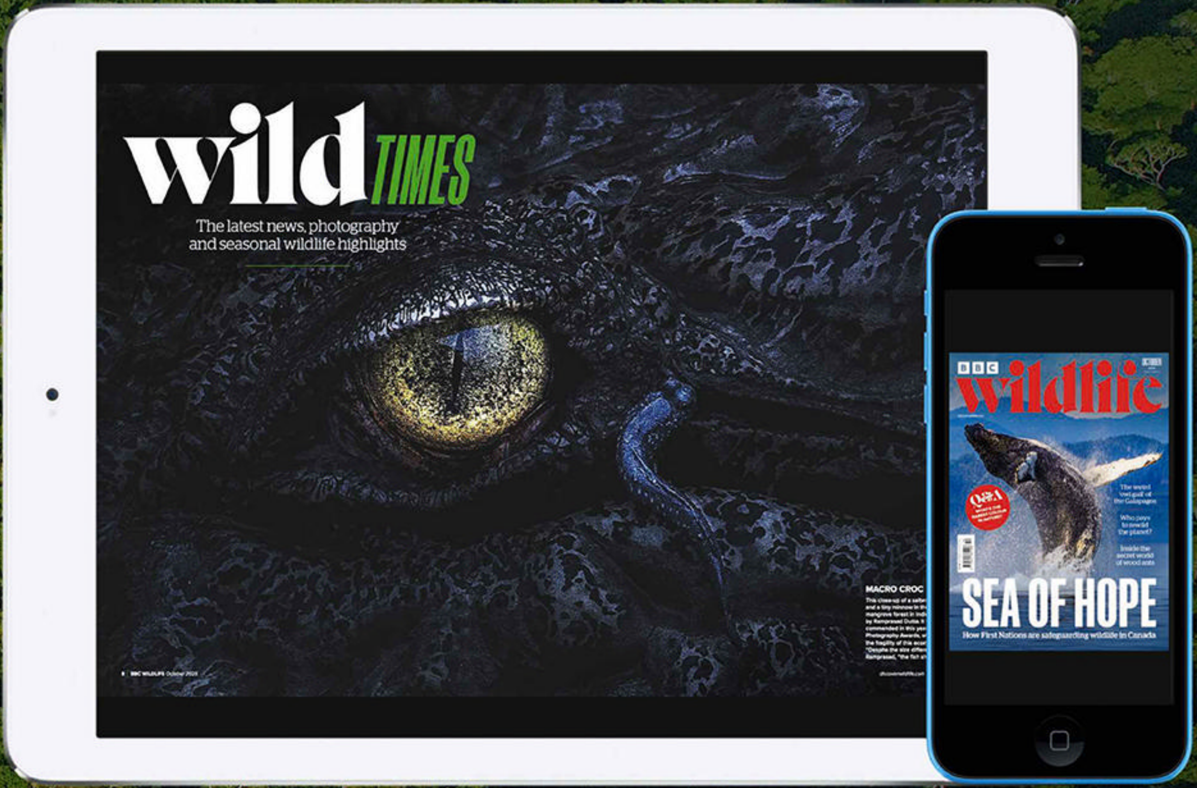
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THE FROZEN CONTINENT

MS Roald Amundsen in Fournier Bay, Antarctica

Humpback whale in Wilhelmina Bay

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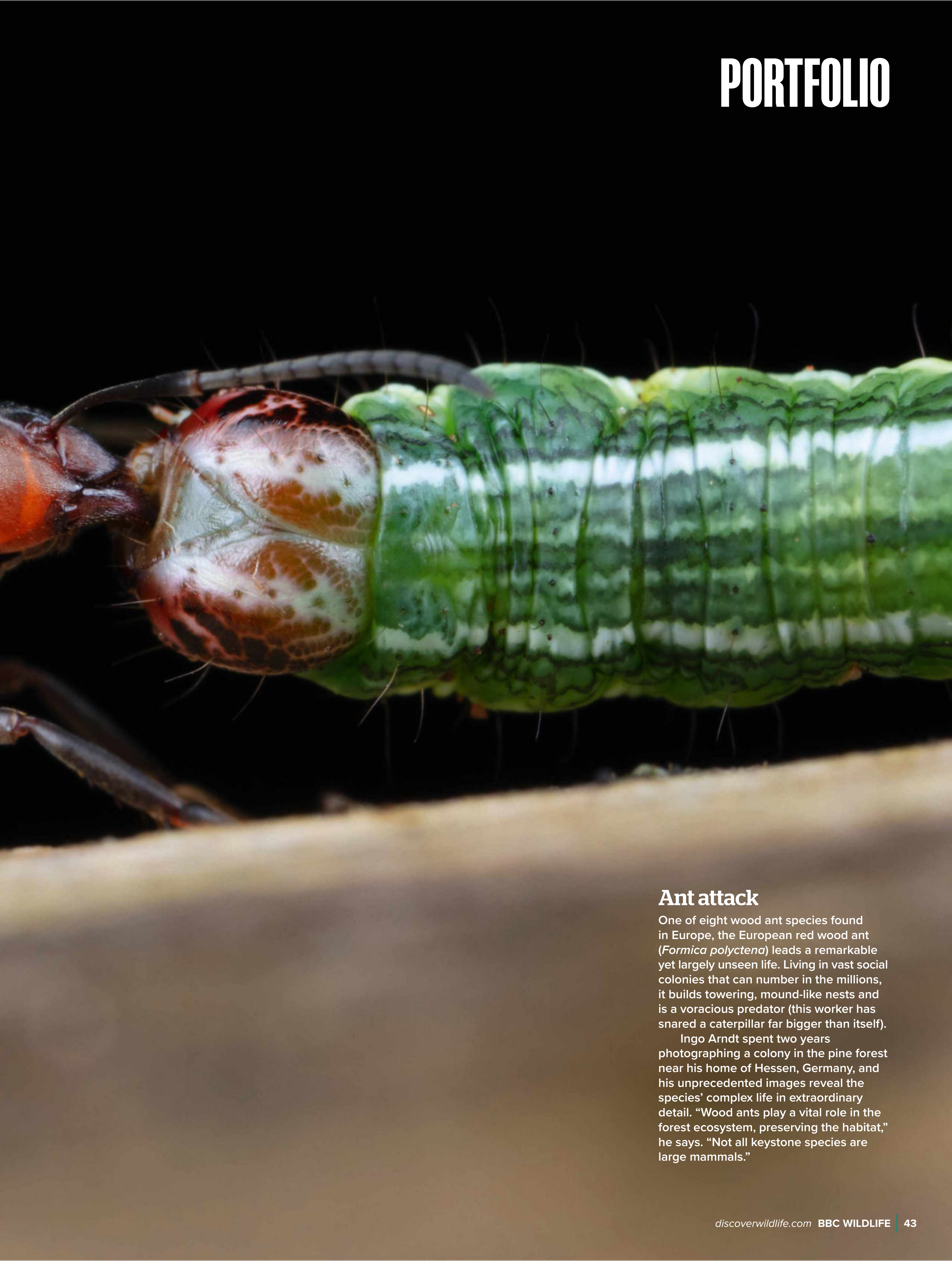
ANTS IN ACTION

Red wood ants are tiny ecosystem engineers that live a secret life in the forest – but one colony has been documented in mesmerising detail

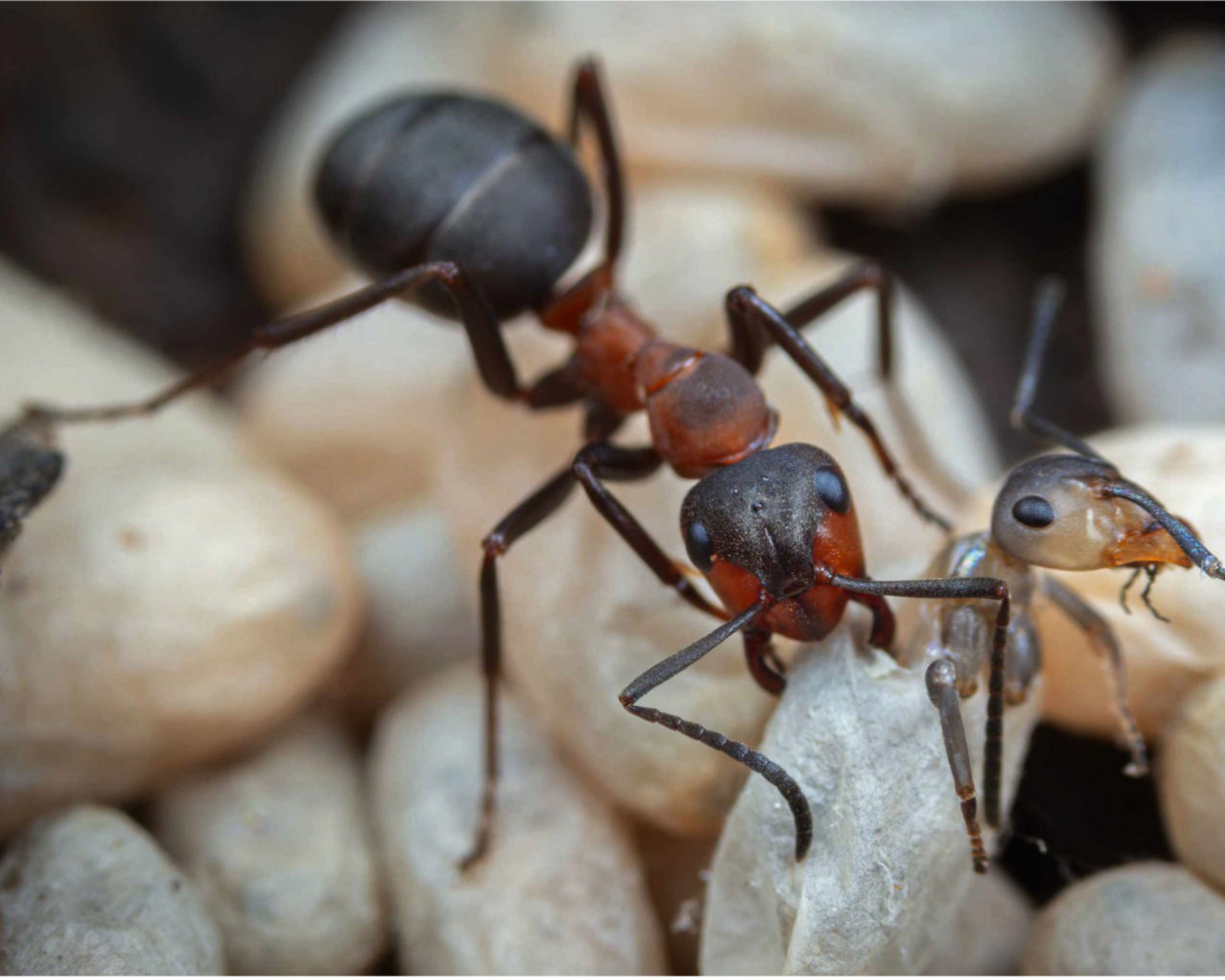
Photos by **INGO ARNDT**



Ant attack

One of eight wood ant species found in Europe, the European red wood ant (*Formica polyctena*) leads a remarkable yet largely unseen life. Living in vast social colonies that can number in the millions, it builds towering, mound-like nests and is a voracious predator (this worker has snared a caterpillar far bigger than itself).

Ingo Arndt spent two years photographing a colony in the pine forest near his home of Hessen, Germany, and his unprecedented images reveal the species' complex life in extraordinary detail. "Wood ants play a vital role in the forest ecosystem, preserving the habitat," he says. "Not all keystone species are large mammals."

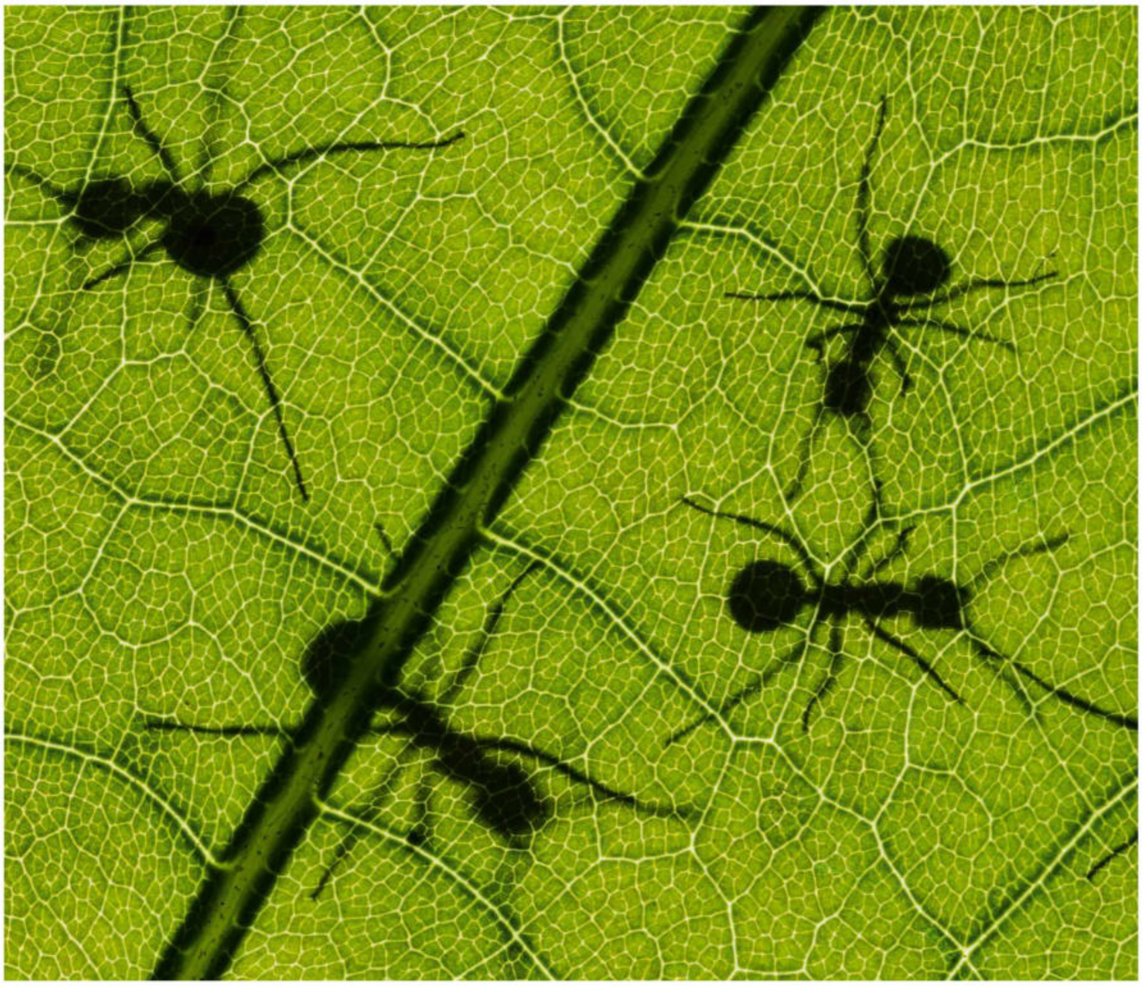


Hatching a plan

As with all ant species, the life-cycle of the European red wood ant starts with an egg, laid by the queen. This hatches into a larva, which pupates inside a cocoon and develops into an adult. When ready to emerge, the ant gnaws an exit hole – but because its body is so tightly folded, it cannot use its legs to push itself out. As seen here, a worker helps to free its new sibling, grooming and feeding it, and transferring a chemical message from the queen that ensures it won't lay eggs. Most new adults are workers, all of which are female and wingless.

Pretty in pollen

While hunting in early spring, a red wood ant clambers over willow blossom, festooning itself in pollen grains. In this way, the species can act as a pollinator.

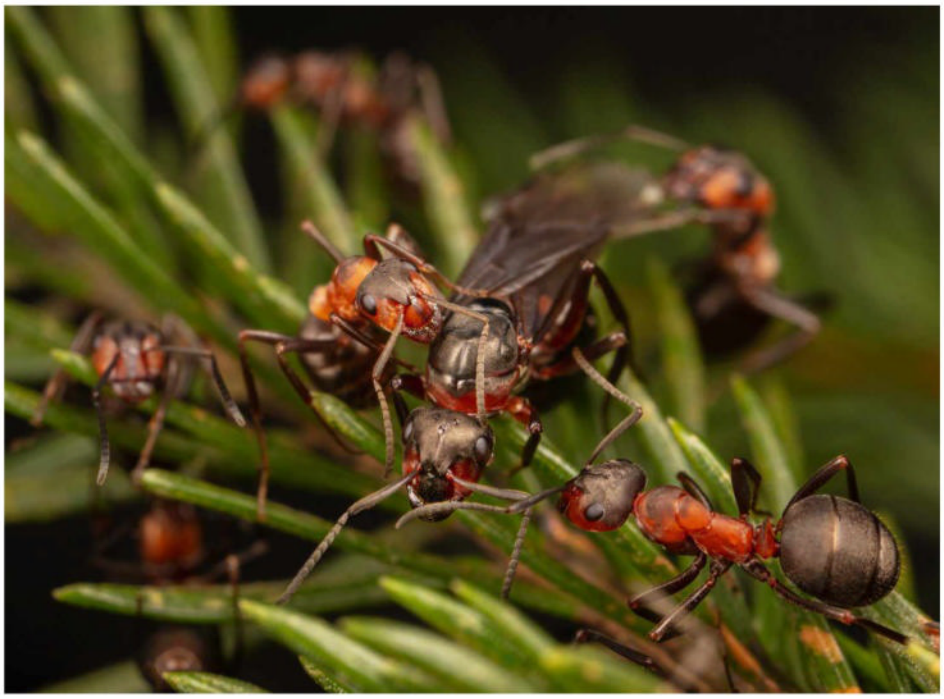


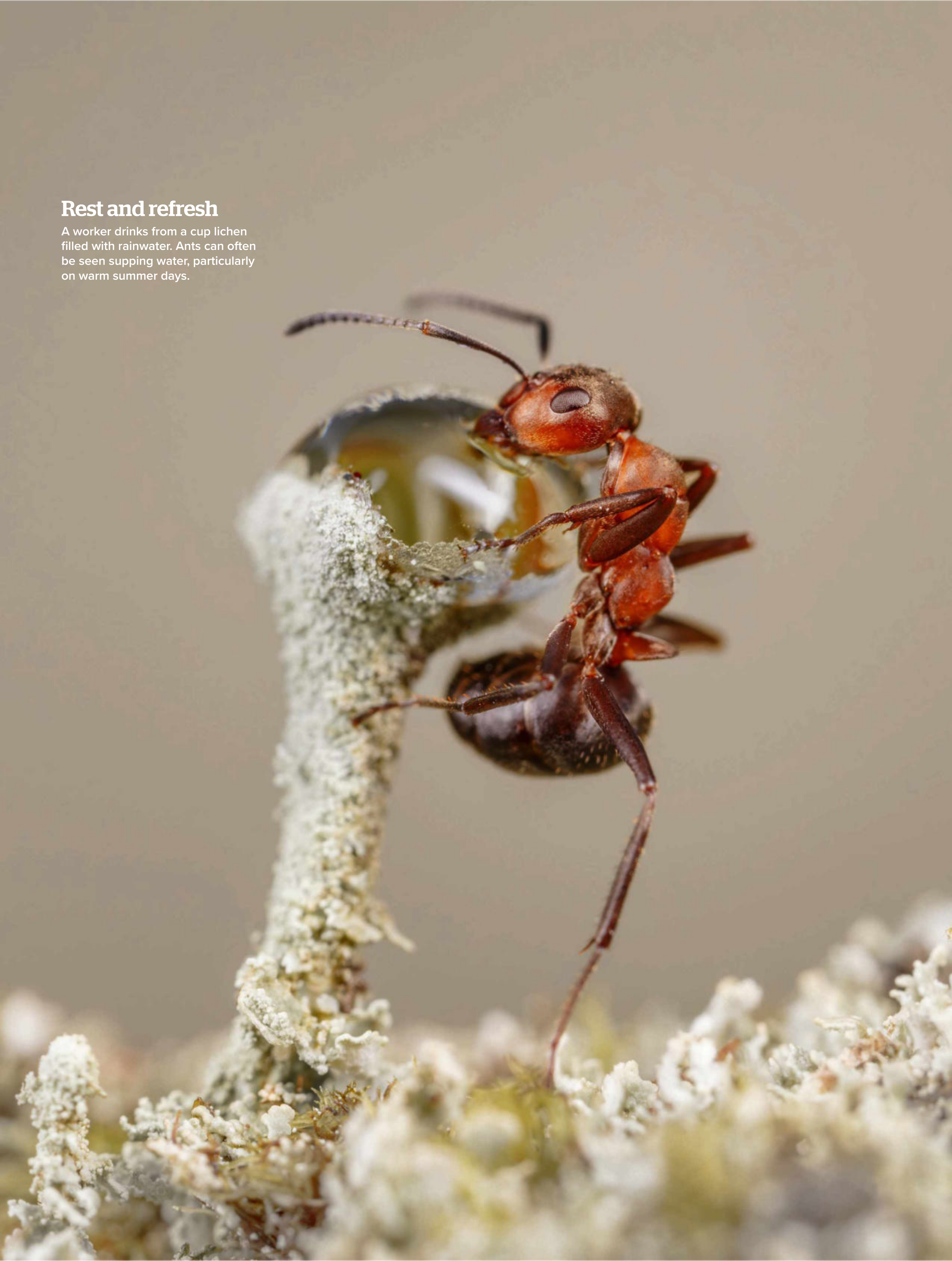
Shape shifters

Red wood ants often climb trees and scour leaves for food. Here, their intricate silhouettes decorate the underside of a sycamore leaf, which Ingo photographed from below.

Time to fly

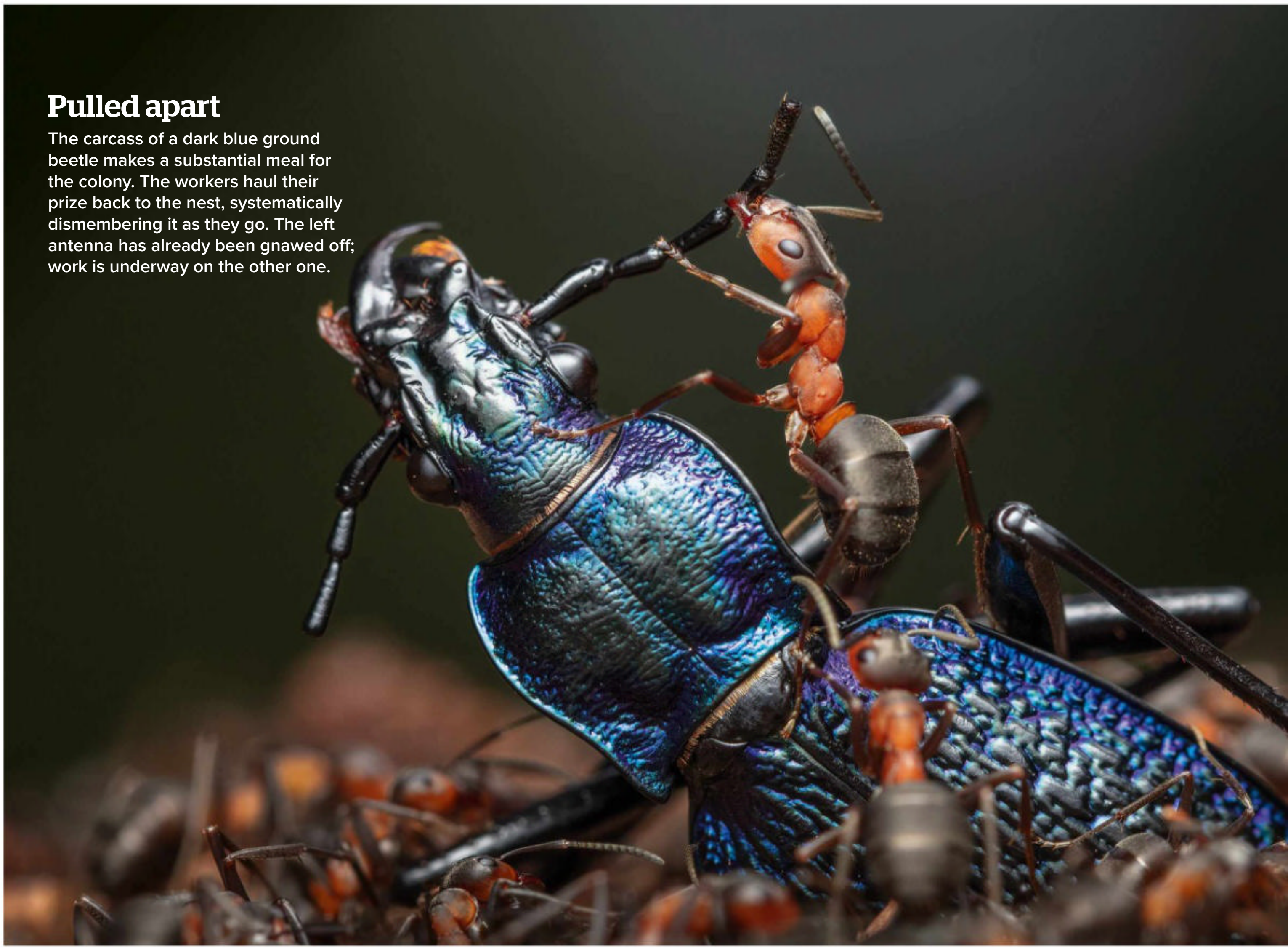
It's swarming day – when males and queens from different colonies gather to mate. This queen, currently being tended to by workers during a brief rest-stop, will soon take flight again in search of a partner. An ant's sex is determined at the moment the queen lays an egg. Fertilised eggs develop into wingless female workers, responsible for foraging and maintaining the nest and its queen. Unfertilised eggs become winged males (drones), whose sole purpose is to breed. When a colony becomes big enough, additional queens are produced in the form of special winged females known as alates.





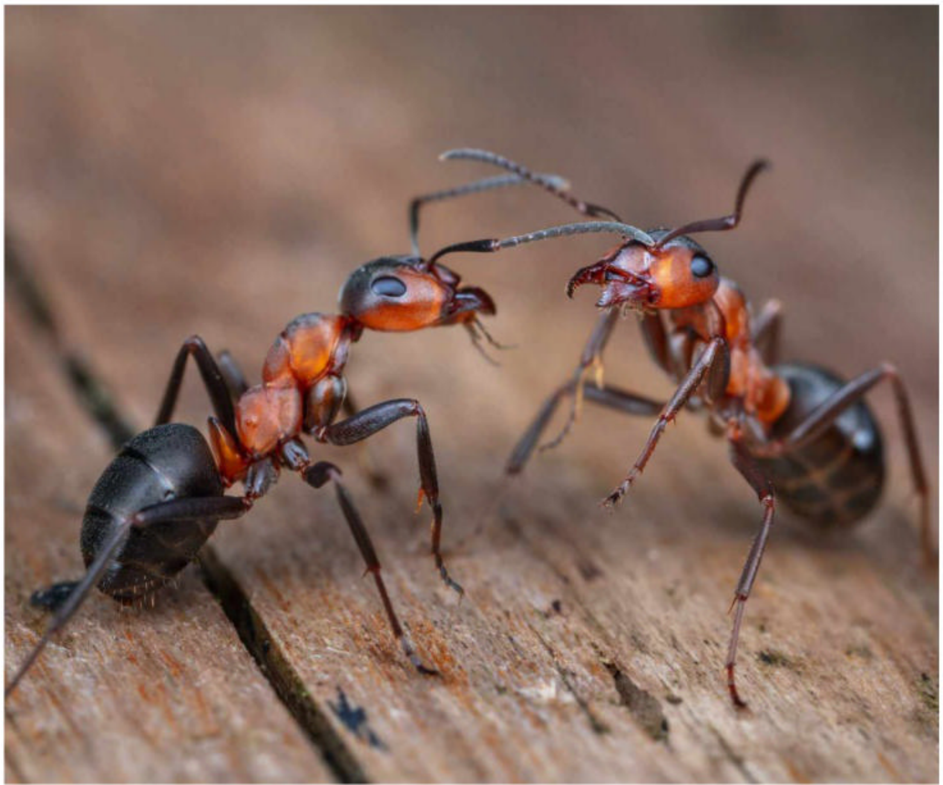
Rest and refresh

A worker drinks from a cup lichen filled with rainwater. Ants can often be seen supping water, particularly on warm summer days.



Pulled apart

The carcass of a dark blue ground beetle makes a substantial meal for the colony. The workers haul their prize back to the nest, systematically dismembering it as they go. The left antenna has already been gnawed off; work is underway on the other one.

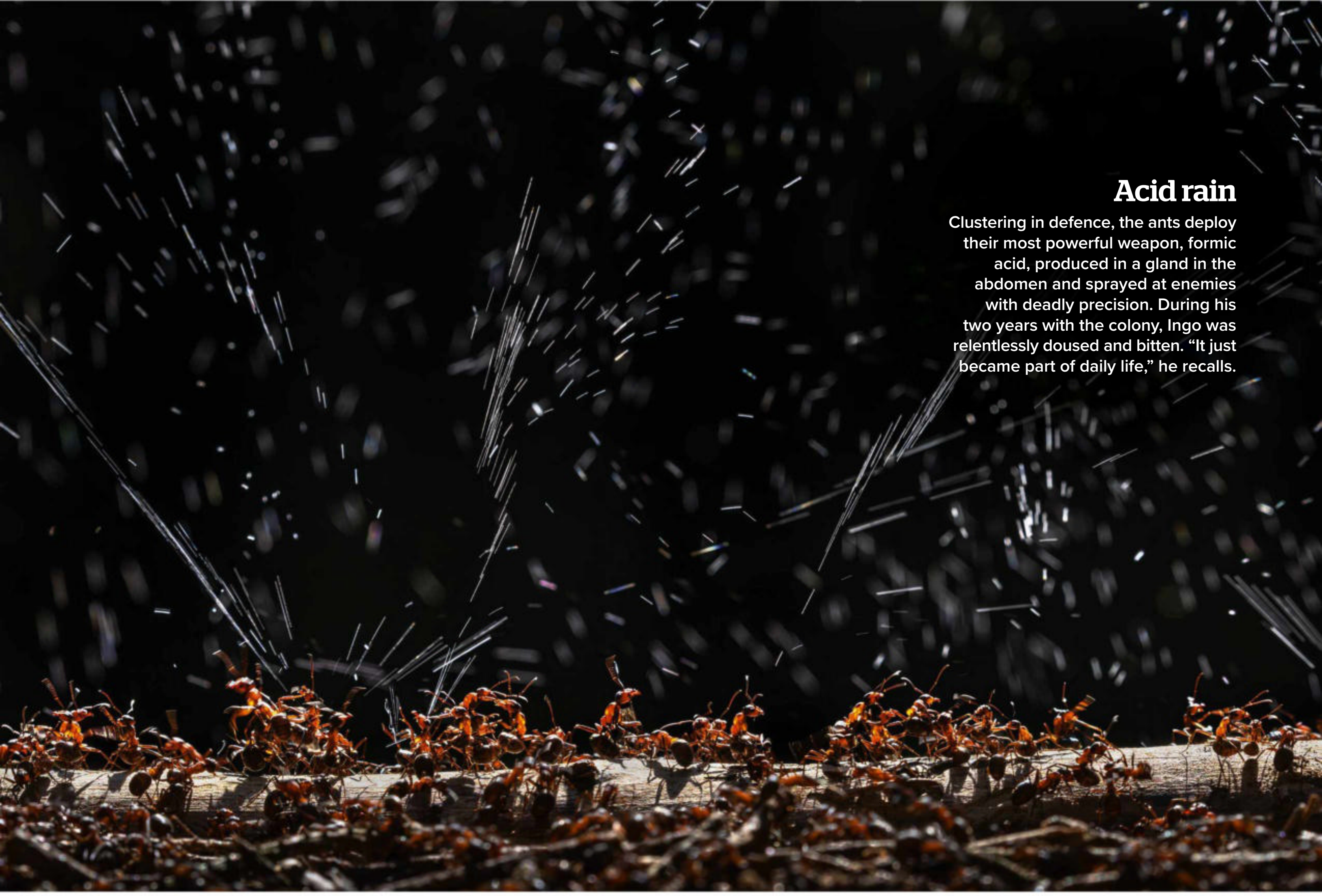


Sisterly love

Additional queens produced within the colony build new offshoot nests. When workers from these neighbouring nests encounter one other, they recognise their shared lineage by scent. There is therefore no need for aggression – instead, the ants engage in friendly probing. “It is fascinating how orderly a colony is,” says Ingo. “What appears at first glance to be chaos actually follows a precise structure.”

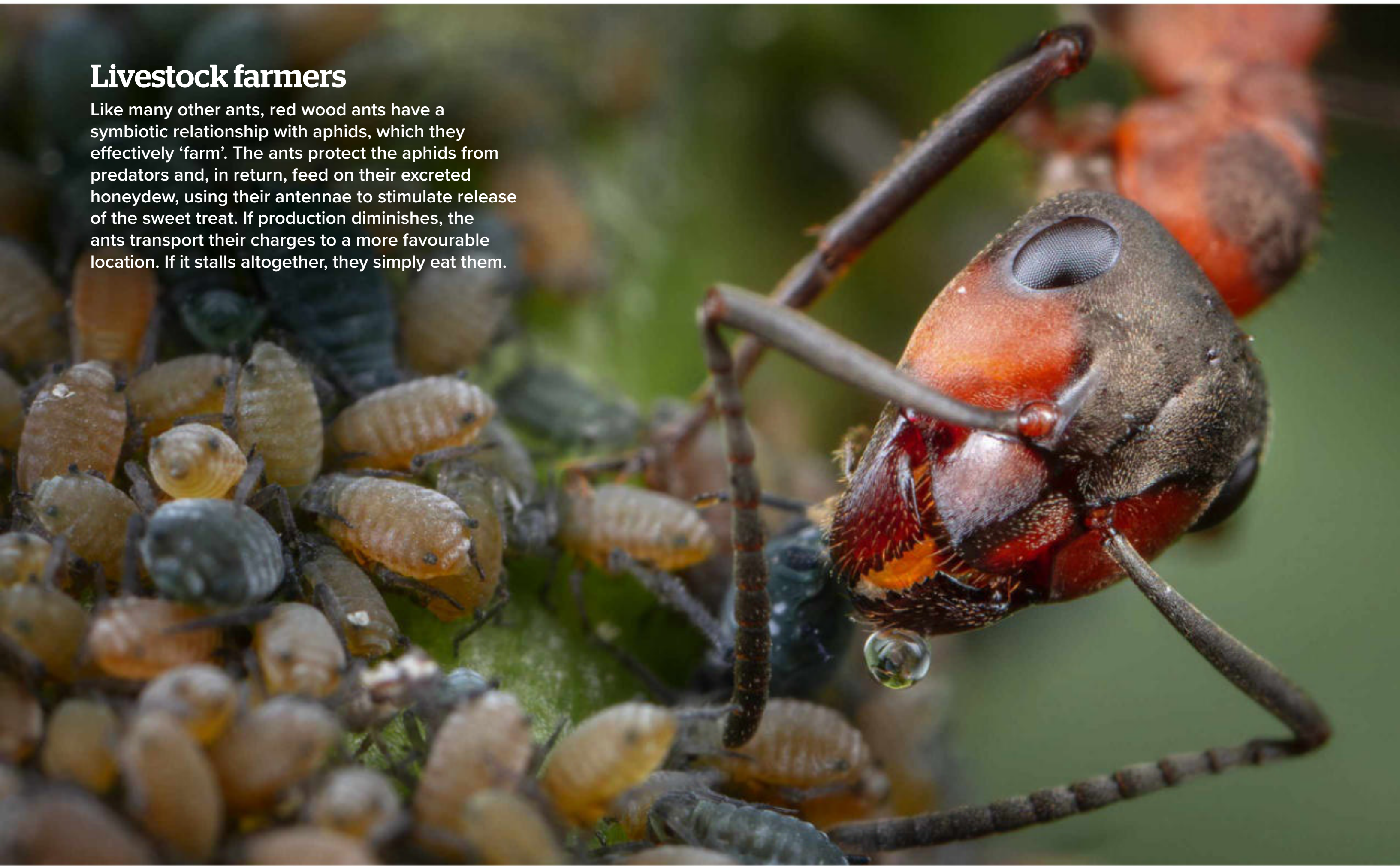
ABOUT THE PHOTOGRAPHER

Ingo Arndt is a leading wildlife and nature photographer from Germany. He has been a multiple winner of the Wildlife Photographer of the Year and European Nature Photographer of the Year competitions.



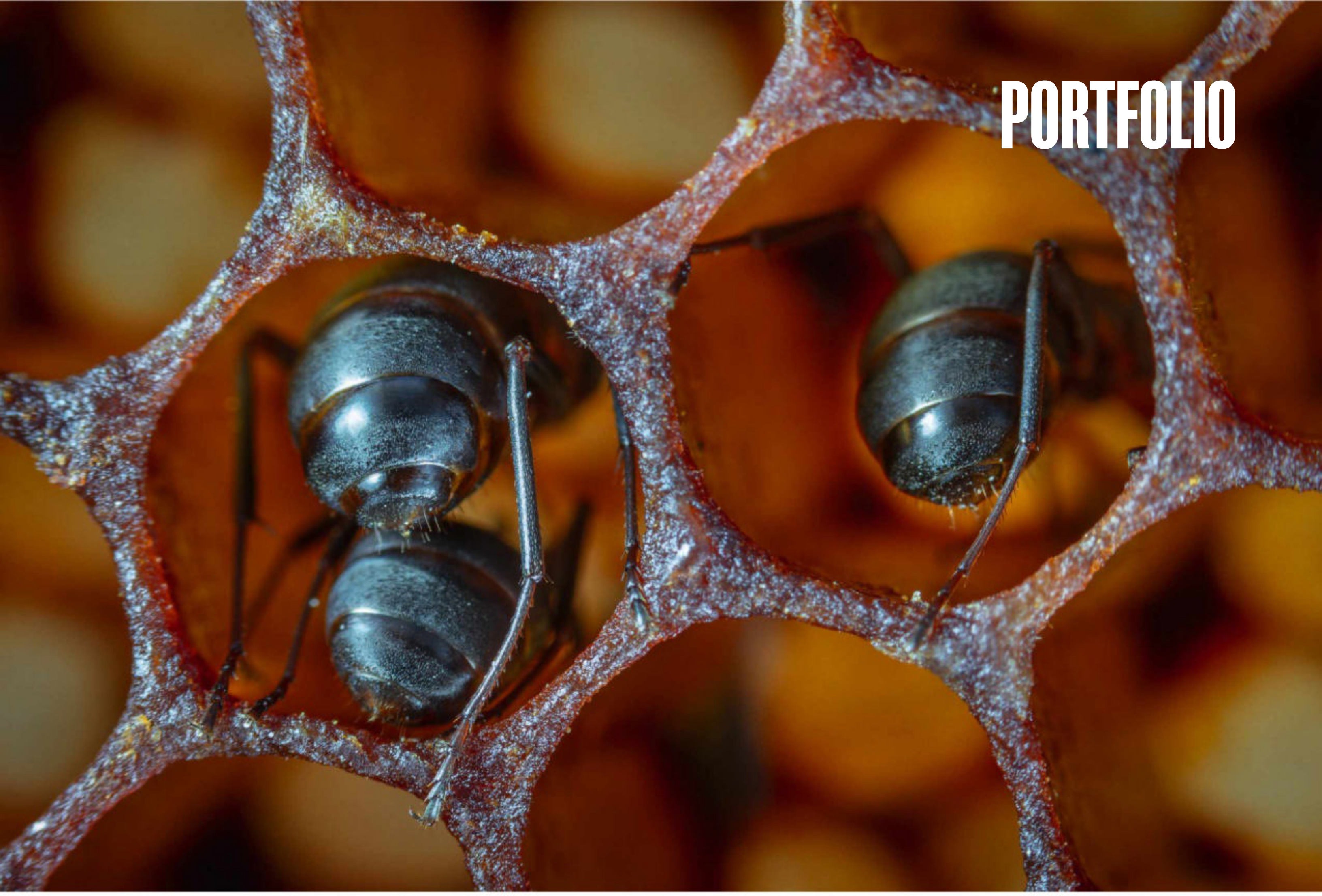
Acid rain

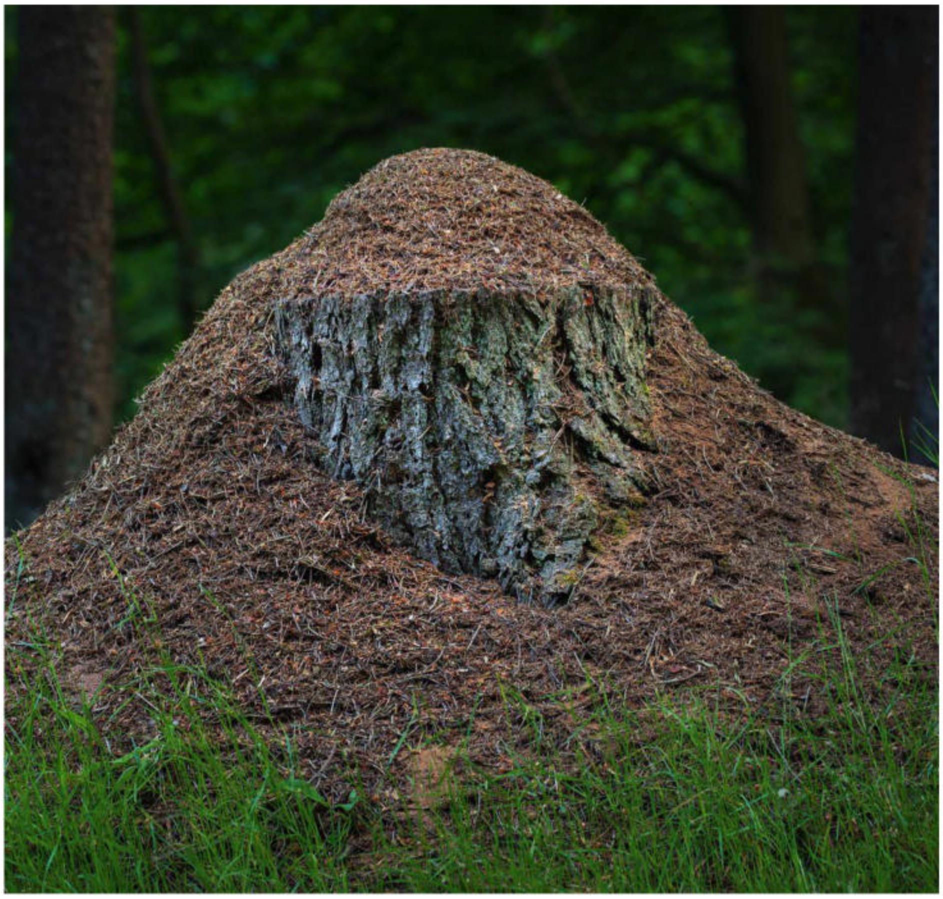
Clustering in defence, the ants deploy their most powerful weapon, formic acid, produced in a gland in the abdomen and sprayed at enemies with deadly precision. During his two years with the colony, Ingo was relentlessly doused and bitten. "It just became part of daily life," he recalls.



Livestock farmers

Like many other ants, red wood ants have a symbiotic relationship with aphids, which they effectively 'farm'. The ants protect the aphids from predators and, in return, feed on their excreted honeydew, using their antennae to stimulate release of the sweet treat. If production diminishes, the ants transport their charges to a more favourable location. If it stalls altogether, they simply eat them.



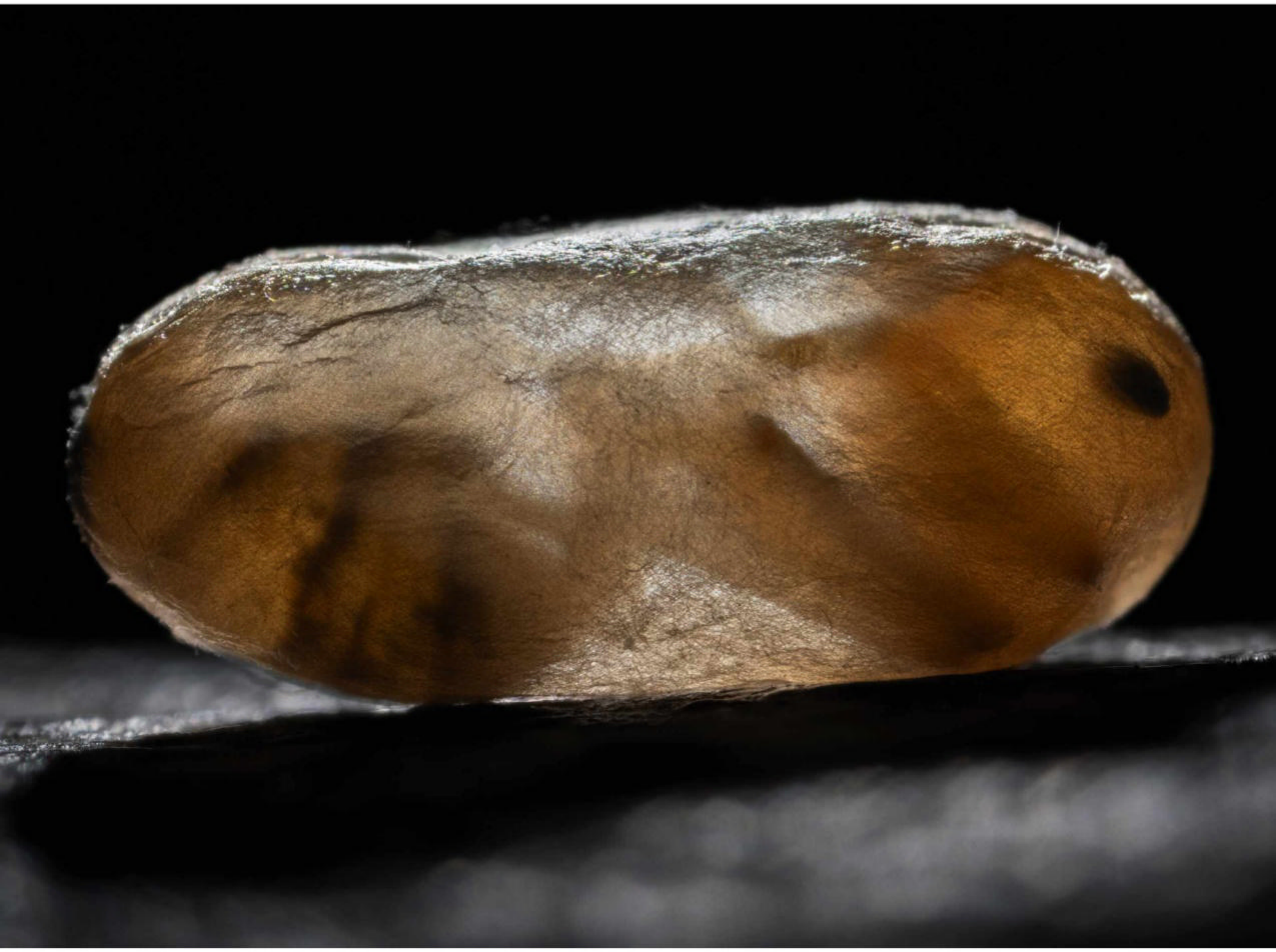


Land of honey

Red wood ants often settle near the nests of wild honeybees. If the honeybee colony doesn't survive the winter, the ants feed on the honey left in the combs. They consume as much as they can, causing their abdomens to swell considerably.

Homing instinct

Wood ants are renowned for their vast and intricate nests. Often, a tree stump forms the central core, providing structural stability. As construction ramps up, the stump is gradually engulfed by building material, which mostly comprises plant stems. The size and shape of the mounds can vary – in shady areas, for instance, they are taller to maximise exposure to sunlight and warmth.

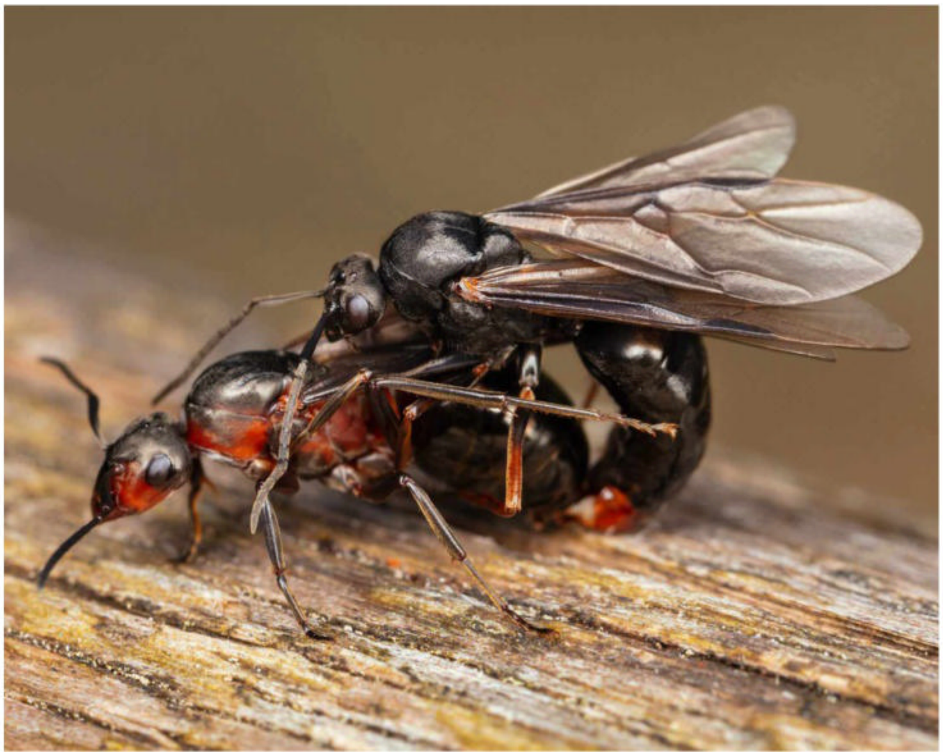


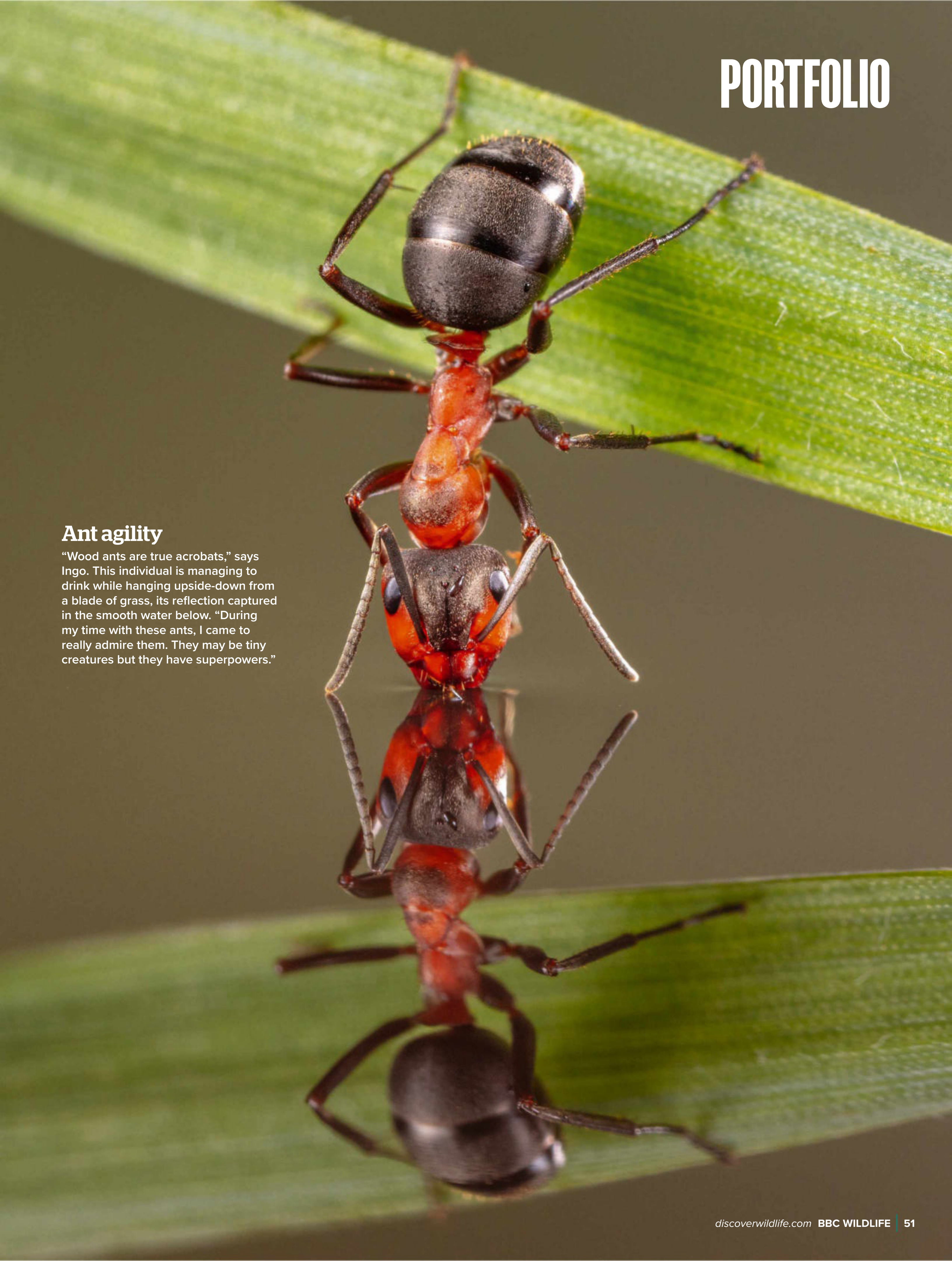
The transformation

A larva spins its silken cocoon with crosswise threads that provide elasticity and stability. When backlit, the casing becomes transparent, revealing the adult growing inside. Note the eye, which appears as a dark spot.

Mating moment

During copulation, the sexual organs of the two partners interlock. Millions of sperm enter the queen's sperm sac, where they remain available for fertilisation for many years. After mating, the male usually dies.





Ant agility

"Wood ants are true acrobats," says Ingo. This individual is managing to drink while hanging upside-down from a blade of grass, its reflection captured in the smooth water below. "During my time with these ants, I came to really admire them. They may be tiny creatures but they have superpowers."

A grizzly bear in the Great Bear Rainforest – the world's largest expansion of intact coastal temperate forest

GRIZZLY BEAR: ROLF HICKER PHOTOGRAPHY/ALAMY

THIS LAND IS YOUR LAND

Indigenous tourism in British Columbia is restoring balance to some of the most spectacular nature on Earth

Words by **PAUL McGUINNESS**

Humpback whale in the Johnstone Strait, along the coast of Vancouver Island

MOUNTAINS PLUNGE SHARPLY into turquoise glacial waters. From the shoreline, the rainforest climbs steeply into the clouds, snowcaps peaking through occasional gaps. My attention is drawn to the shore, as a grizzly bear cub appears, its pale-grey face a stark contrast to the almost black of its sibling. Despite being born in the same litter

The region is a good place to spot the bald eagle, which commonly occurs along rivers and large lakes

> “I turn my attention to a tree where a bald eagle looks out from its nest”

just a few months ago, they almost certainly have different fathers. To the right, their mother flips boulders effortlessly in search of the quarry beneath – mussels, crabs, clams – left by the receding tide.

After a good 15 minutes watching from a respectful distance aboard our skiff, the bears are lured back into the forest by the salmonberries whose sweet abundance provides an alternative to the crustaceans and shellfish on the shore. The berries have only just emerged, encouraged by the clement weather, and are nectar to bears building their strength after hibernation.

The bears now hidden from view, I turn my attention to a tree where a juvenile bald eagle looks out from its nest. My guide, Karissa, explains that this tree is at the edge of her ancestral village. While our excursion here is ostensibly a wildlife watching tour, Karissa isn’t just showing us the local wildlife, she’s allowing us to join her on a journey of discovery through her territory as one of Canada’s Indigenous people.

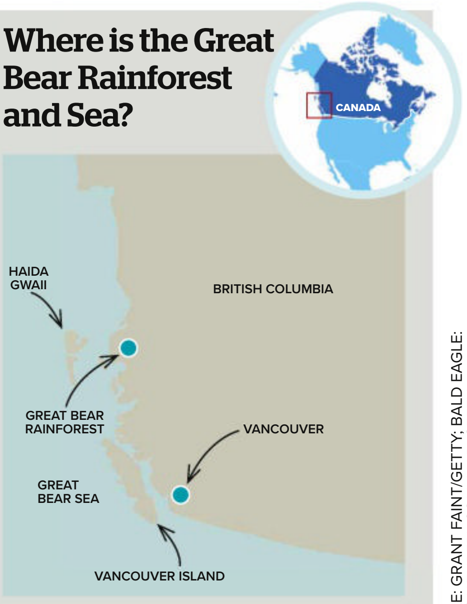
This is my first morning on the delightfully named Great Bear Sea, along the coast of British Columbia, adjacent to the Great Bear Rainforest.

Back in 2000, a number of First Nations came together as Coastal First Nations

ABOUT THE AUTHOR

BBC Wildlife editor Paul McGuinness has a passion for the wildlife of the Americas. He visited Canada courtesy of Indigenous Tourism BC (indigenousbc.com) and Destination British Columbia (hellobc.com).

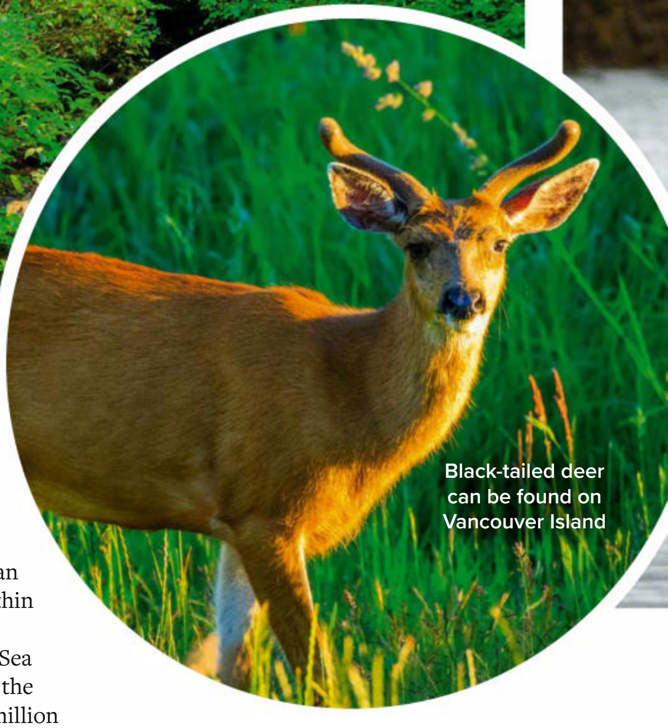
Where is the Great Bear Rainforest and Sea?



In 2024, the ocean that borders the Great Bear Rainforest, along British Columbia’s west coast and islands, was declared a marine protected area.

HUMPBACK WHALE: GRANT FAINT/GETTY; BALD EAGLE: BERTIE GREGORY/NATUREPL.COM; MAP: GETTY

The 8.5 million ha Great Bear Rainforest is home to ancient cedars, mountains, fjords and abundant wildlife



Black-tailed deer can be found on Vancouver Island

(CFN), an NGO and partnership that, in 2005, negotiated what's known as a Project Finance for Permanency, or PFP. In essence, this is a financial model that brings together Indigenous, federal, provincial, forestry and philanthropic stakeholders, and that helped establish a protected area within the Great Bear Rainforest.

In June 2024, in partnership with the government of Canada and the province of British Columbia, CFN announced the Great Bear Sea PFP, a network of marine protection zones in the waters between Vancouver and Alaska. Then-prime minister Justin Trudeau declared, "Indigenous peoples have been the stewards and caretakers of Canada's vast lands and waters since time immemorial."

Visitors flock here to see orcas, grizzly bears and whales, but I'm here to learn about how Indigenous-owned and operated wildlife tourism businesses are protecting the region's wildlife and natural resources.

My first call is with Christine Smith-Martin, executive director of CFN. "We've been stewarding our territories for more than 14,000 years," she says. "It's part of our tradition." With activities such as commercial logging and fishing exploiting the natural resources to dangerous levels, it was vital to the health of the forest and sea that a conservation-based economy was developed. It's pretty heavyweight stuff, both politically and economically. But the difference it's making is miraculous.

"We protected more than 6 million hectares of temperate rainforest, which is very important to us," says Christine. Without this original Great Bear Rainforest PFP agreement, she tells me, 85 per cent of that area would have been logged by now. They've also created more than 1,200 jobs and 130 new businesses within First Nations communities.

Christine believes the Great Bear Sea PFP will have a similar impact. "Over the next 20 years, we're hoping for $734 million of economic impact, with 3,000 new jobs and at least 200 new businesses – and more importantly the implementation of the marine protected area."

But as impressive as these initiatives undoubtedly are, this remains far from a utopia. I've come to Port McNeill, a small town on Vancouver Island's north-east coast, to meet Mike Willie, a hereditary chief of the Musgamakw Dzawada'enuxw. These are Kwak'wala-speaking people, made up of 18 tribes who weren't involved in the Coastal First Nations' enterprise.

"The Great Bear Forest South, which is where my tribes come from, didn't get a seat at the table," he says. "So all of that logging quota had to go somewhere." This logging that could no longer continue in the now-protected neighbouring regions moved into Mike's territory. "We became the industrial zone of the Great Bear Rainforest."

Despite this, Mike remains a supporter of CFN's achievements. "It's a good idea to protect huge areas so that wildlife has a home, as well as the First Nations that live in remote communities, like my people. We need our valleys protected from industry and logging."

Wildlife tourism is a key tool in leveraging this protection, and Mike's Sea Wolf Adventures is an example of an Indigenous-owned and operated business. I spend a day on the water with guides Karissa and Alan. It happens to be one of the most spectacular day's wildlife spotting I've ever enjoyed.

> "From the boat, we spot grizzly bears, humpbacks, dolphins and porpoises"

A family of grizzly bears at Knight Inlet Lodge

From the boat, we spot three grizzly bear families and sit for hours watching humpbacks dive. A pod of around 40 Pacific white-sided dolphins follows our boat, surfing in our wake. We see countless bald eagles and Dall's porpoises, sea otters, seals and maybe 50 sealions – including a pair of bulls squaring up to each other in a dramatic show of aggression. But the excursion is a lot more than ticking species off a list.

OVER LUNCH ALAN TALKS proudly about his traditions and how his people have lived in harmony with these lands for thousands of years. One thing that connects with me is his account of how Indigenous people harvest a tree without killing it – they shave the bark to make clothing, rope or tools, or cut away planks, but leave the tree to heal around the scar. For Alan, every action is done with the consideration of the next seven generations.

"That's a First Nations way," says Mike. "It was always about the future generations." I confess to Mike that before I came here, I'd had the idea that First Nations were

WHO ARE CANADA'S FIRST NATIONS?

First Nations refers to the Indigenous people of Canada, apart from the Inuits and Métis. In British Columbia alone there are more than 200 First Nations, speaking a wide range of languages, and each with their own culture. The one thing they all have in common is a history of persecution – on a shocking scale.

The systematic attempts to eradicate First Nations society and culture came to a head with the scandal around the residential schools system, a cultural genocide that saw an estimated 150,000 First Nations children removed from their families from the late 19th century until the 1990s. Many never returned home.

As well as suffering abuse and malnutrition, thousands of children died and were buried in unmarked graves. The system was closed in 1997, and in 2008 the Truth and Reconciliation Commission of Canada was established, documenting the atrocities undertaken against the First Nations.

RAINFOREST: NICK GARBUTT/ALAMY; BLACK-TAILED DEER: DON WHITE/ALAMY; GRIZZLY BEARS: SHEA WYATT; BOXOUT: DARRYL DYCK/ALAMY

The Pacific white-sided dolphin occurs only in the northern Pacific Ocean

using wildlife tourism as a way to reclaim ownership of their ancestral lands – that by establishing a footprint for his business that covers the extent of his tribe's territory, he was able to stake a legal claim to the land.

"See, that [idea] comes out of ownership," he says. Some First Nations, I learn, believe that they own the land; others don't. Perhaps stewardship is a better term than ownership. Either way, the more I learn about Indigenous culture, the more I understand how fundamentally they are connected to their lands.

And I'm not alone. "A cool thing that happens is people from Canada and around the world come as guests and leave as allies," says Mike. "They recognise that this is our territory. The government can do whatever they want but people recognise that this is First Nations land."

There's a lot of politics involved in working with the provincial and federal government but, talking to Mike, it becomes clear that protecting his territory is as basic to him as protecting his family. "I'm a hereditary chief, my family placed me here. I'll exercise that over anything else."

Bidding farewell to Mike, I head south through Vancouver Island. The landscape is breathtaking, and I feel dwarfed by the magnificence of the forests, lakes and mountains. My next journey involves a flight through the mountains in a 1956 de Havilland seaplane – and for a moment I feel like I'm in a Tintin adventure. We land in the remote Glendale Cove, where I'm to spend the next couple of days in a floating lodge – another Indigenous-owned wildlife tourism business.

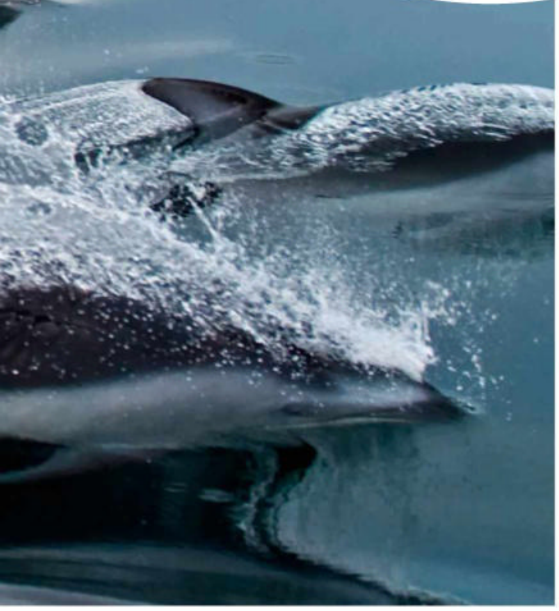
After a refreshing swim, I head out in a kayak. I watch a playful harbour seal and pick out black-tailed deer in the long grass. As I move up the estuary into the shallows, I'm enchanted by a family of mergansers, the ducklings lined up like cartoon characters. The eerie call of a loon pierces the silence.

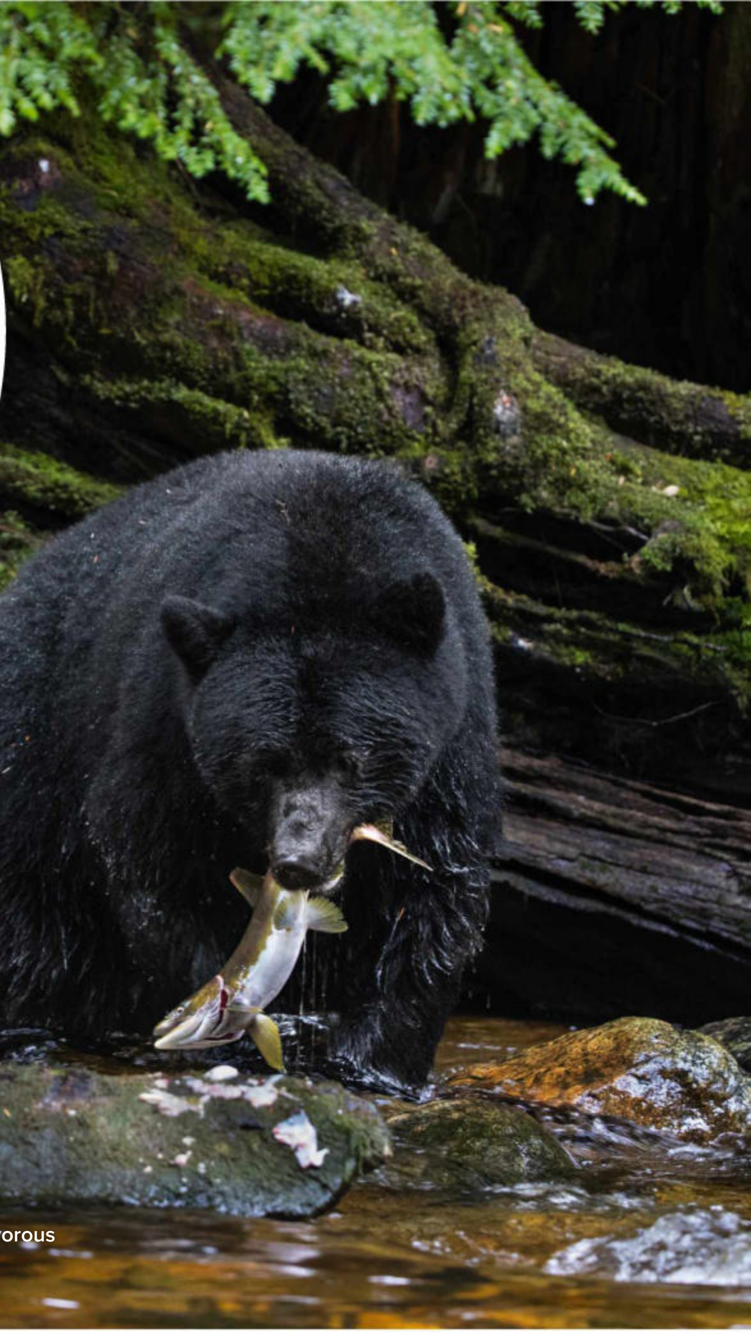
Back at the lodge, while hummingbirds and swallows flit around the deck, I chat with Merv Child, CEO of the Nanwakolas, a partnership of First Nations that operates a number of businesses in the region, including Knight Inlet Lodge.

Having bought the lodge from non-Indigenous owners before Covid, the new proprietors immediately looked to improve the facility and make it more of an Indigenous experience. There's wonderful artwork all around – painted masks hang in the communal dining area and a glorious totem pole stands proudly out front.

"We've actively tried to hire more Indigenous guides," he says. "Right now we have three – they're from the local community and they're wonderful." These come from what's called a guardian watchman programme, where First Nations citizens monitor forestry, fishing and pleasure craft activity within their territories, making sure that tours stick to agreed grizzly bear viewing regulations, for example, and

Sealions spotted on a tour with Sea Wolf Adventures





Black bears have an omnivorous diet, consuming fruit, nuts, roots, ants, fish and more

> “We follow ancient trails shared by villagers and bears, all of whom have been here for thousands of years”

educating outsiders on dos and don’ts. Merv is proud to be rolling out a youth programme, which will bring local, young Indigenous people into the field.

In the morning, one of the Indigenous guides, Harold, leads a final outing. We moor up at the site of a village that was destroyed by a tsunami around 500 years ago, and follow ancient trails shared by villagers and bears, all of whom have been here for thousands of years.

Fresh paw prints and piles of scat tell us that bears are close by. We hike through the rainforest, Harold encouraging me to sample the various berries and leaves that his people have enjoyed for generations, and explaining how they used the trees and plants. Waters gushing from the peaks form rapids. The thought of humans using these paths for thousands of years is as thrilling as the idea of seeing a bear. And then it happens.

“There,” Harold whispers, and I spot a black bear some 50m away, ambling through the forest. It either hasn’t caught wind of us yet or doesn’t care, and I stand, jaw to the floor, watching the animal go about its business. And then it’s back on to the seaplane and away from this paradise. On the way, I mull over how long these lands were managed for the benefit of all living things and how, in such a relatively short period, so much damage was done. I reflect on something Merv said: “The Nations have taken it upon themselves to use various tools to assert their authority back over their territories, and they do it on a government-to-government basis, by negotiating arrangements.”

This idea of asserting their authority on their territory helps me finally get to grips with the ideas of ownership and stewardship that I’ve grappled with since first arriving in BC. I find myself humming the Woody Guthrie song *This Land is Your Land*.

In my conversations with Merv, Mike, Christine and other First Nations, they all expressed visions of how this nature-based economy will grow. The idea of an integrated tourism operation that involves many Nations working together is a common thread. As Merv says, “We’re trying to align everything, and ultimately that will lead to great stewardship of the natural world that we have here.”

DOLPHINS: HP CANADA/ALAMY; SEALIONS: INDIGENOUS TOURISM BC/ SEA WOLF ADVENTURES; BLACK BEAR: SUZI ESZTERHAS/NATUREPL.COM

Supersized animals should not be taken for granted – Earth's great, hulking giants are biological phenomenons

Words by **BEN GARROD**

LET'S GO LARGE

BBC SOUNDS

Colossal Creatures, part of the *Curious Cases* series, is available on BBC Sounds

AFRICAN ELEPHANT: WIM VAN DEN HEEVER/NATUREPL.COM

The polar bear is the largest bear in the world and has dinner plate-size paws

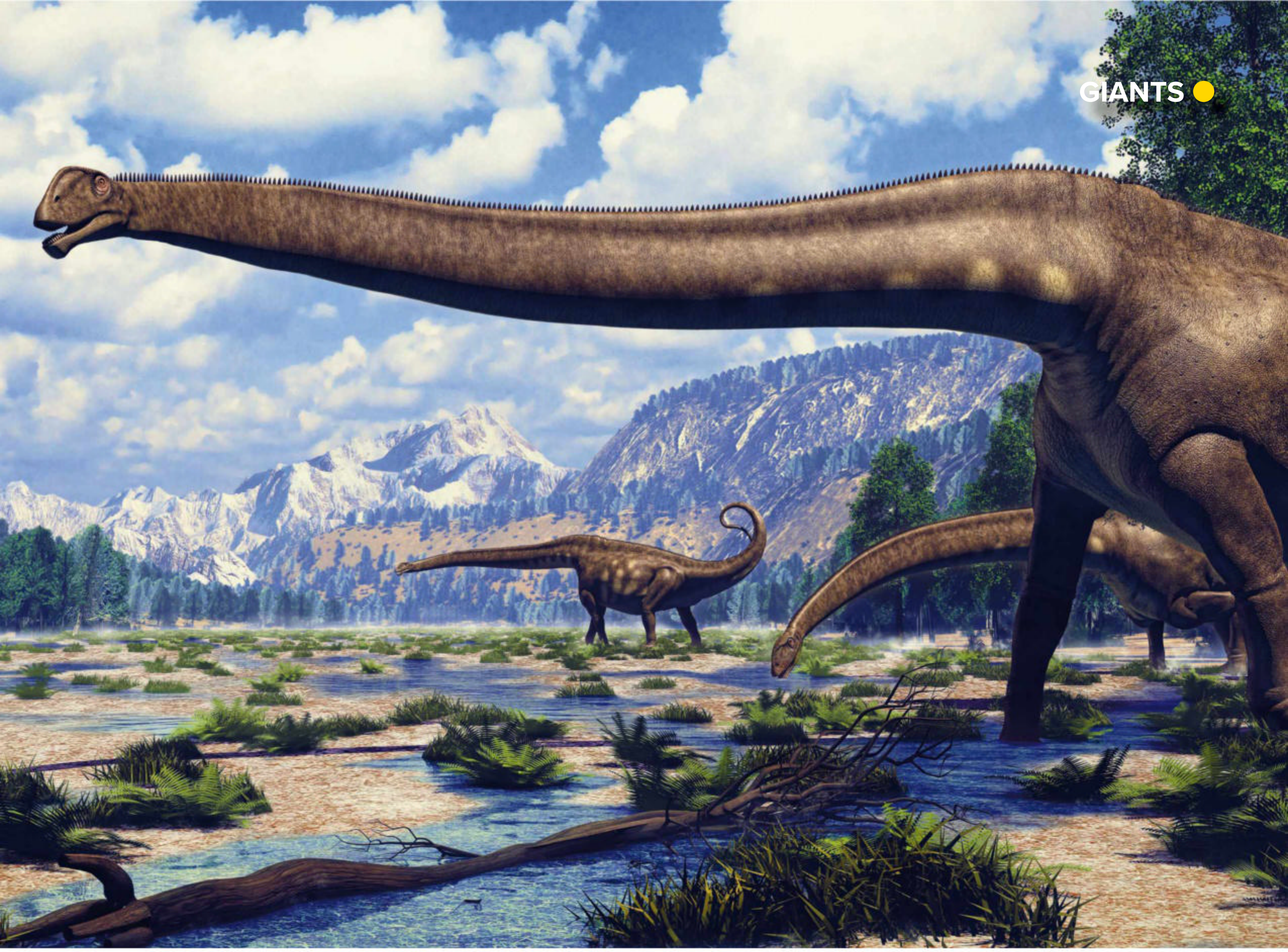
The gigantic *Diplodocus* weighed about 15 tonnes and was about 26m long

FEE-FI-FO-FUM! IT MAY not make a great deal of grammatical sense, but this phrase is certain to conjure up mental images of magic beans, rampant beanstalks and one very angry giant.

Colossal-sized humans and beasts are the stuff of our oldest legends, our favourite fairy tales and our scariest films. But as is often the case in the natural world, fact is stranger – and far more interesting – than fiction. While car-sized ants, a skyscraper-scaling ape, and a physics-defying mosasaur from a certain Hollywood dinosaur franchise may be scientific impossibilities, the physiology, anatomy and ecology of supersize wildlife are still fascinating, full of rules that nature ignores at its peril.

Before exploring why it is impossible for an elephant-sized cat – or even a cat-sized ant – to exist, it is worth looking at why a species might find itself on an evolutionary pathway to becoming huge. The main advantage of biological gigantism is likely to be reduced predation. If you find yourself among the ranks of the mega-sized, you're more likely to be able to defend yourself, or you'll simply be too large to consume.

A bigger body also means a bigger digestive system, enabling larger animals to exploit a different dietary niche, subsisting on lower-quality food simply by eating more of it. For instance, by developing multi-chambered stomachs and increasing the



surface area of the gastrointestinal tract via the addition of specific internal structures – or even just increasing the overall length of the digestive tract – large dinosaurs could eat trees such as the infamously unpalatable monkey puzzle (*Araucaria araucana*). Giant African ungulates, meanwhile, including the ancient rhinoceros relative *Paraceratherium*, could make a fair meal from the tough bark and nutritionally poor leaves of the acacia.

Finally, being large decreases the risks posed by heat loss, which can be a matter of life and death for many animals. Small mammals such as shrews have a fiercely high metabolism and an almost constant need to eat to keep their bodies warm and functional. Larger animals, by contrast, retain more heat because they have a smaller surface area relative to volume. In other words, less area for heat to escape compared to the amount of heat produced.

With gigantism offering so many plus-sized points, you might wonder why the natural world isn't packed with huge beasts. Yet going supersized is neither a simple nor quick process. It involves complex biomechanics, carefully applied to form and function. A mouse, for example, cannot simply be 'stretched out' to be the size of an elephant. A mouse skeleton comprises a delicate framework of long, slender limb bones, connecting at angles that allow these nimble rodents to leap and bounce. Without the thick, column-like legs and reinforced joints that elephants have evolved to support their 5-tonne bulk, an ele-mouse would, sadly, collapse under its own weight.

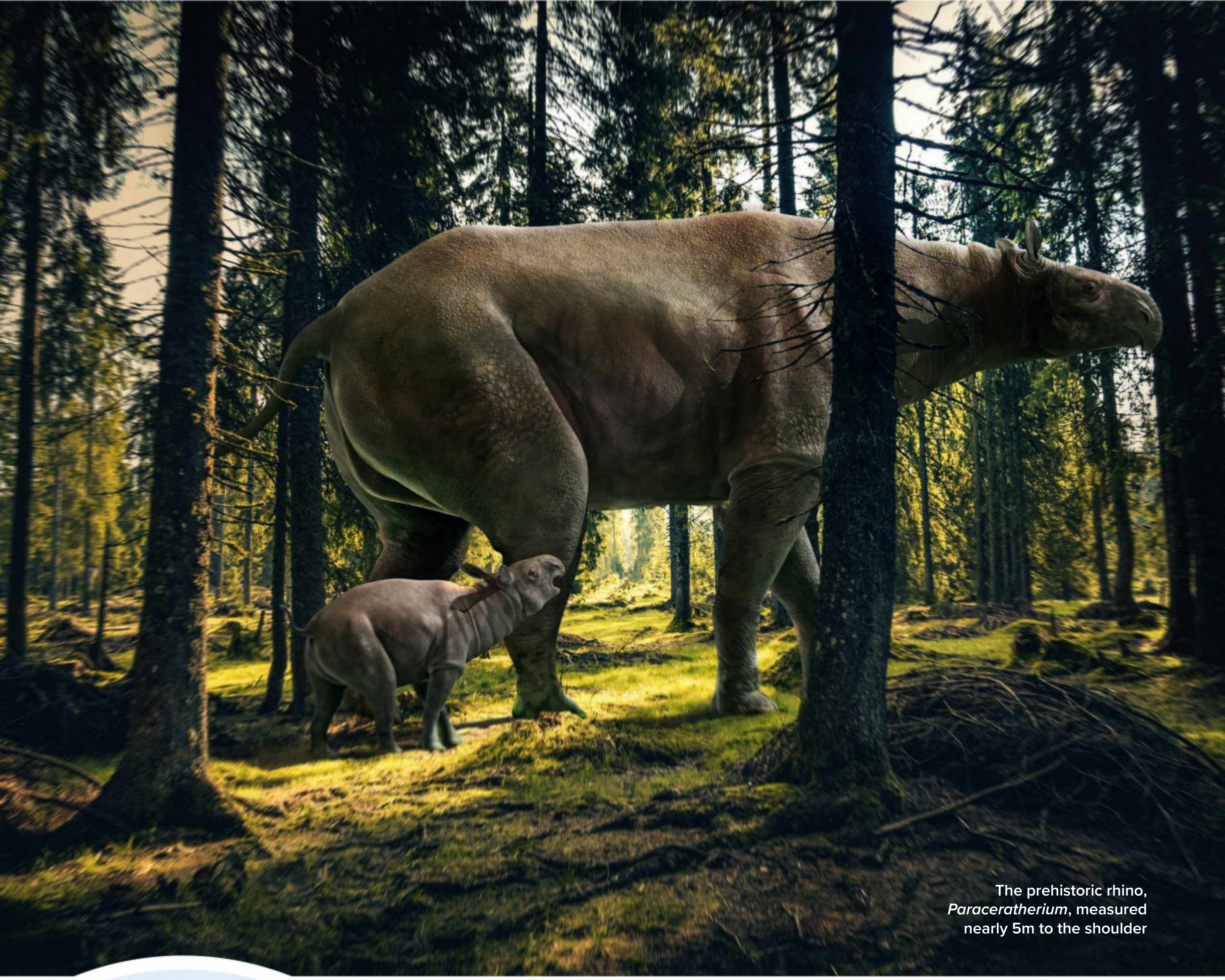
An organism increasing (or decreasing) in size is known as scaling, and there are two approaches to this. One, known as isometric growth, is when an animal increases in size while retaining the proportions between its features. Frogs are a good example, but the phenomenon certainly doesn't apply to all species. Say, for instance, a hamster was scaled up to be as large as a rhino. It might be cute but a mega-hamster would run into problems pretty quickly, because of something known as the square-cube law. As the hamster (or any organism) doubles in length, its surface area increases fourfold, but its volume increases eightfold.

> "A mouse cannot simply be 'stretched out' to be the size of an elephant"

TO UNPICK THE MATHS, IMAGINE your hamster simplified down to a single 1×1 square. The area of this 'hamster' would be 1 (1×1 = 1). The volume (because your hamster isn't flat) would also be 1 (1×1×1 = 1). If we now attempt to double our subject in size, to 2×2, we get an area of 4 (2×2 = 4). And if we look at this new, larger hamster in 3D, we immediately see the problem of volume, because 2×2×2 = 8.

Our poor huge hamster now has eight times more biological tissue to support through nutrition and respiration, yet the surface area of the features that support those processes – lungs and bones, for example – has only increased by four. This

POLAR BEAR: DANNY GREEN/NATUREPL.COM; DIPLODOCUS ILLUSTRATION: GREGOIRE CIRADE/SCIENCE PHOTO LIBRARY



The prehistoric rhino, *Paraceratherium*, measured nearly 5m to the shoulder

White rhinos are the second-largest land mammal

fundamental mathematical principle is why we don't, sadly, see enormous hamsters roaming around.

The other way an organism grows is through allometric growth, where certain bodily features develop at a different pace to the overall growth-rate of the organism. It's much more common than isometric growth, and it explains why human babies are born with proportionately big heads and why a fiddler crab has a single large claw.

However we try to scale up an animal, its volume will grow faster than its surface area. It becomes heavier more quickly than it can gain the strength or surface area to manage that weight, and will ultimately reach a threshold where its limbs can no longer support it. Even if those limbs did grow big enough, the bones inside would be so thick and heavy that the animal wouldn't be able to move adequately. This imaginary super-giant would also need lots of food. In order to sustain a more demanding metabolism, mammals need roughly 10 times the amount of food compared to a similar-sized reptile or dinosaur. It might not be so coincidental, then, that the largest dinosaurs were around 10 times bigger than the largest land mammals.

AS MASSIVE LAND ANIMALS GO, you can't really do much better, or bigger, than the titanosaurs, a group of sauropod dinosaurs, which theoretically may have been able to obtain an upper limit of 120 tonnes. But when you take into account the biological considerations, such as food requirements and sufficient mobility to avoid predators, the sizes reached by the *Patagotitan* and the *Argentinosaurus* (around 60 and 70 tonnes respectively, according to the Natural History Museum, though these figures are debatable), are a realistic maximum.

Aquatic gigantism tells a different story. Living in water is not quite cheating but does allow animals to sneakily side-step many of

WHITE RHINO: TUI DE ROY/NATUREPL.COM; PREHISTORIC RHINO: JOSE ANTONIO PEÑAS/SCIENCE PHOTO LIBRARY

A single enlarged chela is brandished by an orange-clawed fiddler crab

the biomechanical constraints seen on land. Water's buoyancy removes the stress and load on limbs, while effectively reducing the overall weight of the body. Long, filter-feeding plates allow baleen whales to continuously cruise nutrient-rich waters to eat enough plankton to sustain their massive bodies and, while there is some debate about a truly huge prehistoric ichthyosaur, the blue whale is still the official record-holder. With a brain weighing nearly 7kg, a heart the size of a small car and arteries so wide an adult human could squeeze down them (I am still to test this theory), this 30m-long ocean wanderer has been known to reach a staggering 190 tonnes.

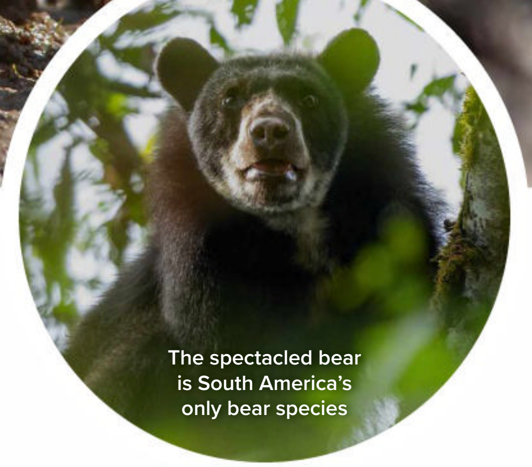
It is no coincidence that we see larger animals across our ocean ecosystems. It is a trend that has been running for more than half-a-billion years. Research shows that over the past 542 million years, the average size of a marine animal has increased by a factor of 150, allowing them to move faster, exploit new habitats and consume larger prey.

In addition to simply making a standard animal bigger and bigger, there is a series of scientific rules and principles by which organisms are bound, in an evolutionary context. Under the 'island rule', for instance, introducing a large species to an island typically results in it shrinking over time, whereas a small species will find itself becoming much larger. 'Allen's rule' states that species living at higher latitudes often have shorter, thicker limbs, explaining why a polar bear's limbs are proportionately stockier than those of a sun bear. And 'Bergmann's rule' refers to the trend that, within a biological group, populations and species of a larger size are found in cooler regions, while species of a smaller size stick to warmer climes.

THE CLASSIC EXAMPLE TO demonstrate this is the bear. The relatively small spectacled bear inhabits equatorial regions, larger black and brown bears live in more temperate regions, and the largest of the group, the polar bears, are found at the highest latitudes, in Arctic habitats.

All things considered, if we wanted to create a supersized land animal, we may need to build upon the idea of taking a population of small dinosaurs and sticking them on a large island, somewhere near the Arctic, with enough food and not too many predators, and see what happens over time.

If we wanted to create the largest aquatic animal, then maybe we are looking in the wrong place with our supersized cetacean celebrities. As a curveball, maybe we could look at colonial organisms such as the giant siphonophore – a vast, tubular community of smaller, identical organisms known as zooids, all working as one and effectively existing as a superorganism. Reaching a diameter of 15m and stretching nearly 50m in length, some of these biological entities could engulf a blue whale whole. The only real downside for a siphonophore is its structural fragility. Also, the fact it weighs next to nothing, and is technically not a single animal, means it may not fit within the criteria of being a 'giant' animal.



The spectacled bear is South America's only bear species

Achieving 'giant' status is only half the story. In order to sustain a colossal size, animals need to employ a suite of anatomical and physiological features to make daily life achievable. Pneumatised, 'air-filled' bones combine into lightweight but strong skeletons that can also be co-opted into the respiratory system, reducing overall weight. Layers of tight-fitting connective tissue known as fascia, wrapped around the legs, prevent blood from pooling and help increase blood pressure across the circulatory system. Both these adaptations were seen in our largest dinosaurs, and many of our largest land animals today employ these biological 'pressure stockings'.

It is easy to assume the giants in nature have disappeared. The fossil record shows that in the past there were bigger dinosaurs, reptiles, birds, fish and insects. Yet huge and impressive beasts still roam among us, from the African elephant to the giant squid. And let's not forget the largest animal ever to have lived on Earth: the blue whale.

> "To sustain a colossal size, animals need to employ a suite of anatomical and physiological features"

ABOUT THE AUTHOR

Ben is professor of evolutionary biology and science engagement at the University of East Anglia, and is also a broadcaster and author.

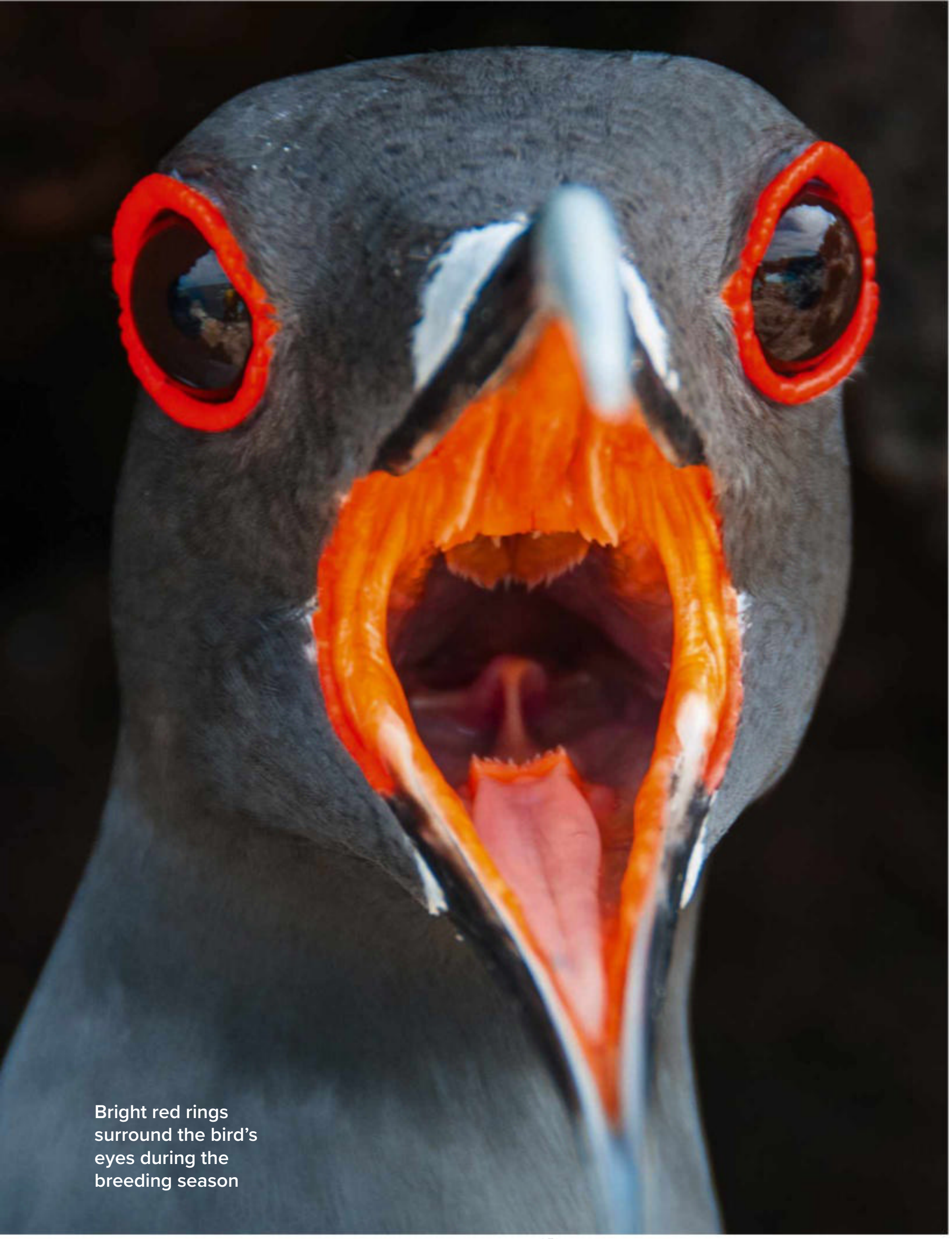
FIDDLER CRAB: BRUCE THOMSON/NATUREPL.COM; SPECTACLED BEAR: LUCAS BUSTAMANTE/NATUREPL.COM; BEN GARROD: CHRIS VAUGHAN

THE MYSTERIOUS OWL GULL

Far away in the Galápagos Islands, a peculiar nocturnal seabird is finally starting to give up its secrets

Words and photos by **TUI DE ROY**

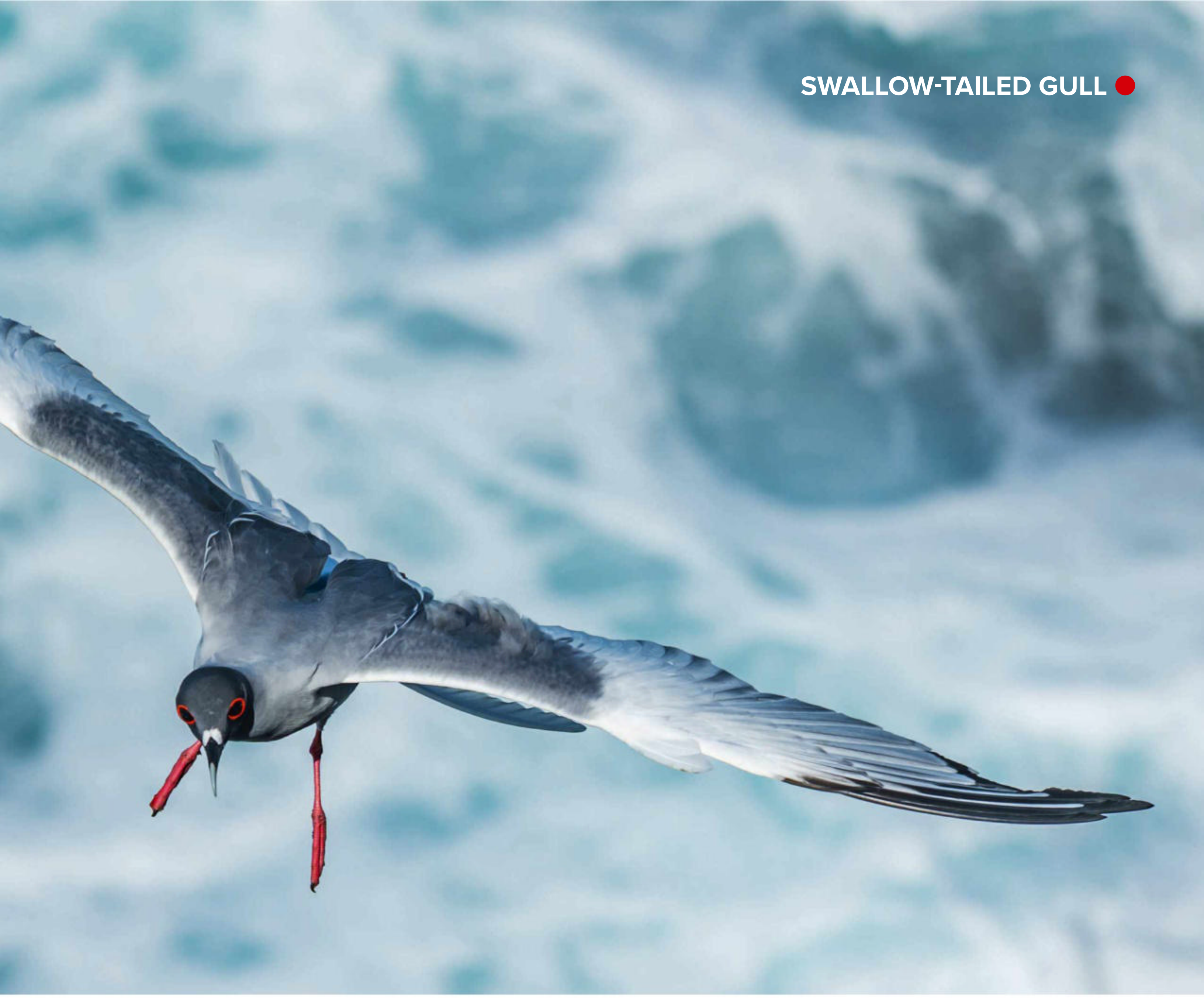
The gulls are found predominantly in the Galápagos Islands, around 1,000km west of Ecuador



Bright red rings surround the bird's eyes during the breeding season

The gulls are often observed feeding 500km from the nearest land

GHOSTLY WHITE FORMS DRIFTED LIKE white handkerchiefs on the brisk night breeze, dipping, rising, flapping, turning and tumbling over an inky black ocean. My small sailing boat rocked gently on the waves, while a handful of stars blinked between the clouds above. The shoreline lay some 30km ahead, just visible as a faint smudge on the horizon, but my gaze was fixated on these spectral beings in constant motion.



That experience was more than half-a-century ago and remains one of my favourite teenage memories. I was living on the Galápagos – as I still am today – and, back then, moving between the archipelago's islands involved hand-steering from the open cockpit of a small boat. I was just 17, working as a naturalist and deckhand, taking the first very small groups of visitors to see 'my' islands. We travelled at night so we could spend the days exploring on land. Those white handkerchiefs over the sea were in fact swallow-tailed gulls (*Creagrus furcatus*), found only in the Galápagos and in tiny numbers on Malpelo Island, off Colombia, some 1,600km to the north-east. And they weren't aimlessly blowing past the boat: they were hunting – in near total darkness.

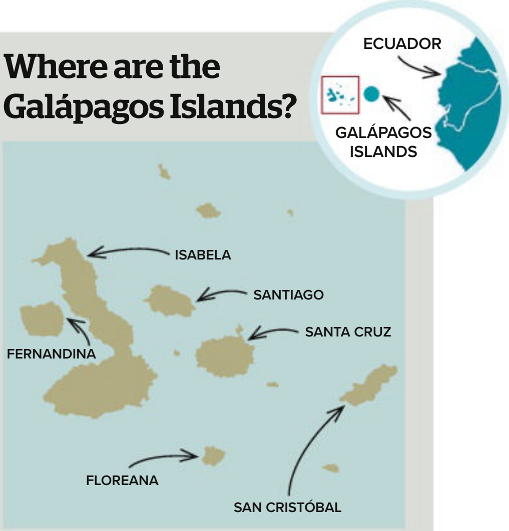
I watched them for hours that night, barely visible in the dim glow of the navigation lights, swooping down and back up with extraordinary agility. They emitted strange, shrill crackling noises, mostly when they suddenly dipped low over the lightless sea surface. It was utterly captivating.

The swallow-tailed gull is an exceptionally beautiful bird, elegant and seemingly weightless on the wing, and exquisitely coloured when observed up-close. Its plumage is adorned in striking shades of grey, white and black, and during the breeding season, its huge black eyes are encircled by brilliant red rings. The entire inside of its gape is decorated in a lighter

ABOUT THE AUTHOR

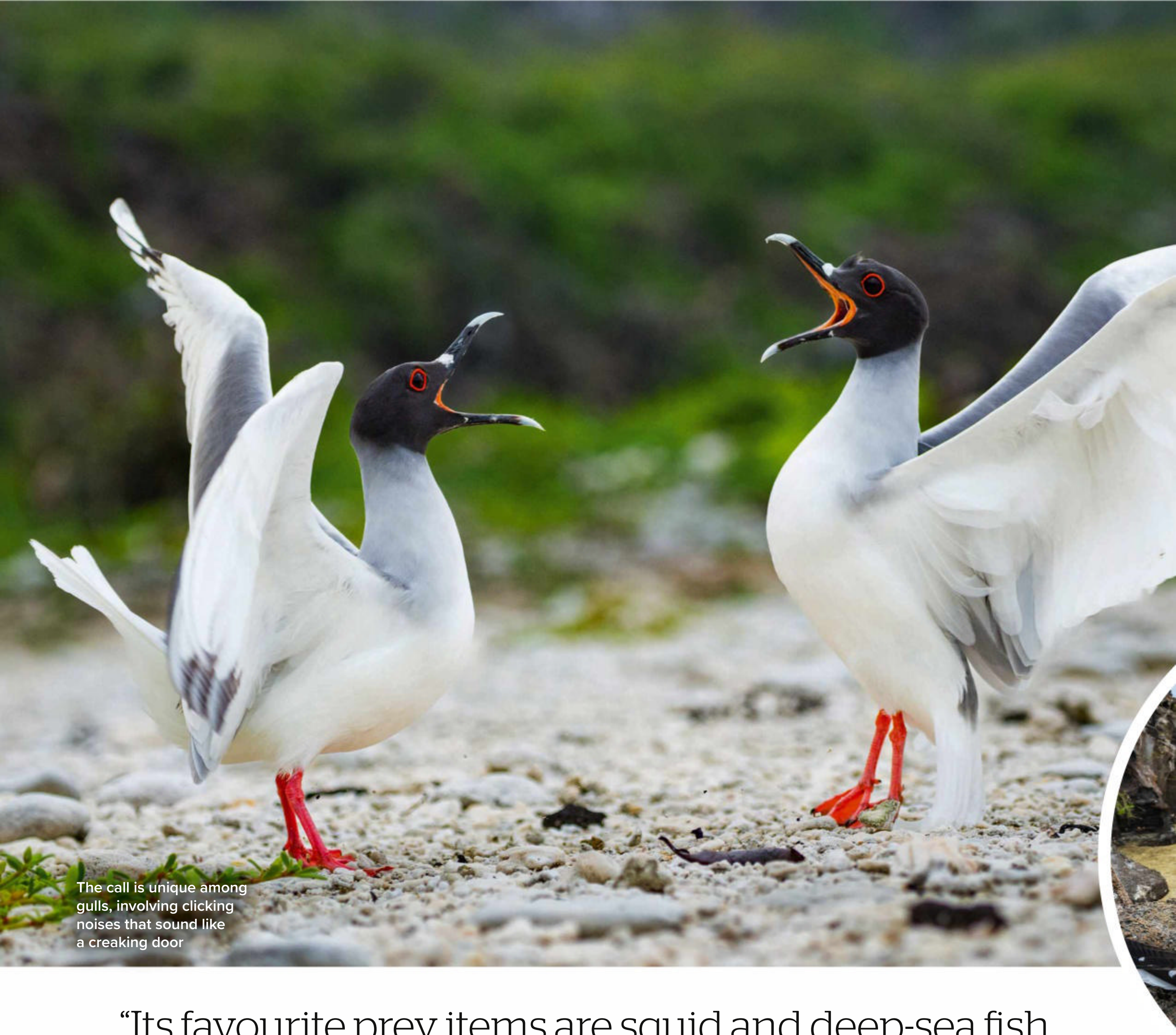
Tui is a renowned wildlife photographer and author raised in the Galápagos. She has written more than 20 books, including *A Lifetime in Galápagos*. For more information, see tuideroy.com.

Where are the Galápagos Islands?



The Galápagos comprise a group of 19 islands, and scores of islets and rocks, on the equator in the eastern Pacific Ocean.

MAP: GETTY


The call is unique among gulls, involving clicking noises that sound like a creaking door

> “Its favourite prey items are squid and deep-sea fish, which rise from the ocean depths in the dead of night”

shade of orange, displayed during minor disputes and when making its signature, high-pitched alarm call.

It’s also unique. It’s the only gull in the world that is nocturnal, earning it the nickname of ‘owl gull’. And, unlike its cousins, which are either coastal or even range into lakes and rivers far inland, the swallow-tailed is a pelagic seabird, living in the open sea outside of the nesting season.

Nesting can happen at any time of the year, provided food is abundant – the birds are asynchronous breeders, meaning they don’t stick to a fixed reproductive season. As a result, while colonies are never empty, not all birds are present at any given time. Each pair has its own breeding cycle of 9–10 months, roughly half of which is spent raising a single chick. The remainder is spent far from the Galápagos, mainly off the coast of Peru, in the heart of the Humboldt Current, with the birds never making landfall. This is when their dapper black hoods moult to white, and the bright red rings around their bulging round eyes fade away. When they are ready to nest, they moult again, regaining all those contrasting colours, ready for their return to the archipelago.

As nocturnal hunters, returning to their nests before dawn, swallow-tailed gulls tend to spend their days quietly. They doze through the hottest hours, with just the occasional territorial scrap interrupting the peace. Only when the sun dips below the horizon does the colony come to life, the birds’ drawn-out screeches serving as signals for small flocks to lift off and head for the far horizon.

These nightly hunting forays aren’t random searches for food, as might be the case in other scavenging gulls. The swallow-tailed’s favourite prey items are squid and deep-sea fish, elusive sea creatures that rise from the ocean depths in the dead of night in search of plankton.

Various other comings and goings take place in the darkness, with parent birds

Adults stand guard at the nest during the day

The gulls breed year-round in the Galápagos

exchanging incubating and chick-guarding duties. Night-time on land is dangerous even for a nocturnal gull, as short-eared owls, which have equally good vision, prowl the colony for vulnerable youngsters. Other potential predators include larger gulls, hawks and herons.

SUNRISE MARKS A NEW HUBBUB OF activity, and this is my favourite time to observe a colony. The birds pay no attention to my presence, and I can watch them for hours, pondering the many secrets their lives still hold. Pairs will be variously courting, building nests from tiny pebbles or fragments of coral, engaging in protracted mating rituals, or feeding their chicks regurgitated squid. Often, panic will break out when a marauding frigatebird attempts to steal the catch, with neighbouring birds joining forces to form a screaming, whirling, defensive mob.

Parents take it in turns to brood their single egg or nestling, and might delicately preen each other's facial feathers in a gesture of tenderness. In a courting pair, the female will sometimes 'beg' like a chick, peeping with her head low and beak upwards. An attentive partner will respond by regurgitating an entire squid for her.

Every so often I am left utterly incredulous by the gigantic size of some of the squid that are served up to both partners and chicks, already partially digested. How these birds manage to catch such hefty creatures in total darkness, and haul them all the way back to shore in their distended stomachs, is anyone's guess.

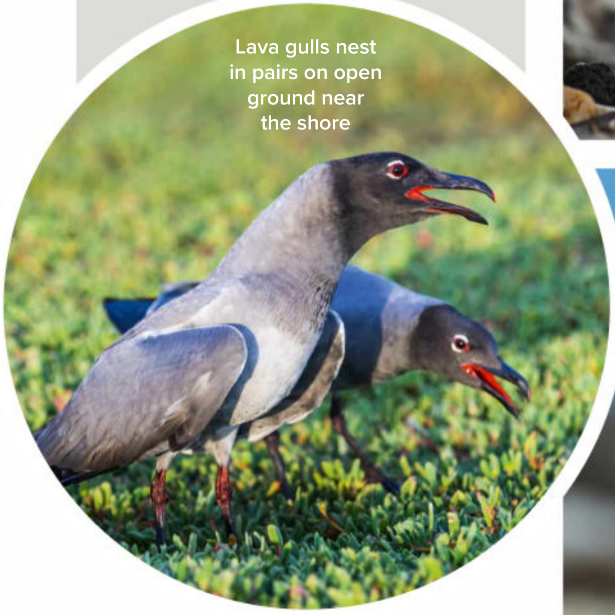
There is still a lot we have to learn about the swallow-tailed gull but, in recent months, remarkable research has uncovered tantalising new insights, piquing my interest in these birds all over again. A study using tiny satellite-trackers, led by ornithologist and Galápagos native Sebastián Cruz, has demonstrated that this is the only known seabird that actively prefers to fish on the darkest nights.

CRUZ AND HIS TEAM DISCOVERED that the swallow-tailed gull has a flexible sleep schedule, adjusting its activities in response to the lunar cycle. The brighter the moon, they found, the less the birds were absent from the colony. The pattern suggests that swallow-tailed gulls forage at sea when normally deep-dwelling prey are most abundant at the surface, feeding in the darkness to avoid detection. Interestingly, Galápagos fur seals

WORLD'S RAREST GULL

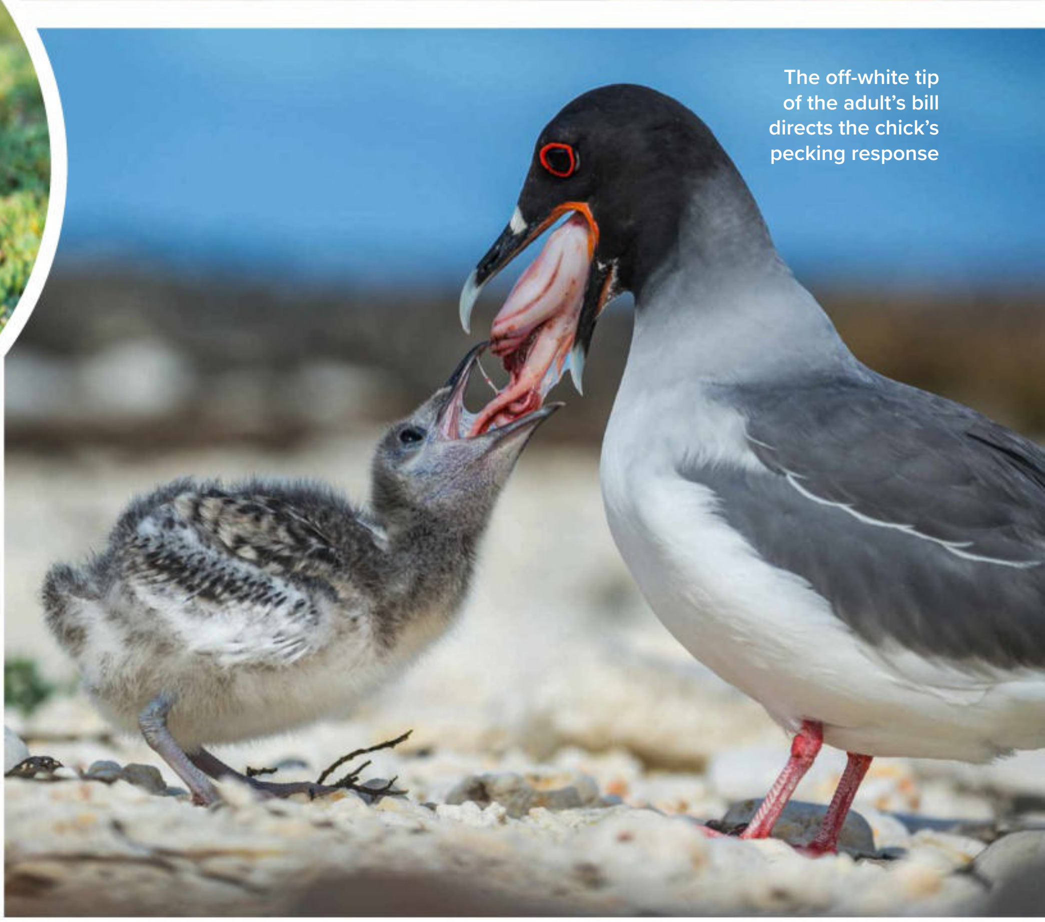
The lava gull

The Galápagos boast another endemic gull – the lava gull. Its plumage is slate grey and black, providing excellent camouflage along the volcanic shoreline. It lives in pairs or small family groups and is the world's rarest gull, with a total population of about 500 individuals. As a traditional scavenging gull, it faces stiff competition from frigatebirds, which probably explains its low numbers.



Lava gulls nest in pairs on open ground near the shore

Parents take it in turns to look after their single egg



The off-white tip of the adult's bill directs the chick's pecking response

schedule their foraging activity in a similar manner: like the gulls, they rely heavily on nocturnal squid.

The study also found that swallow-tailed gulls roam far and wide on their night-time foraging trips. Tracking individual birds travelling from distinct colonies to known feeding grounds far out at sea, the researchers revealed that the gulls were exceeding distances of 100km per night. It's an incredible new finding – though just how this species manages to hunt and travel in pitch darkness, in a way that is completely different to other members of its family, is still not fully understood.

Look carefully at a swallow-tailed gull and there are some clear adaptations that enable its night-hunting behaviour. Most obvious are the enormous eyes, equipped with bulbous, light-gathering lenses and a tapetum lucidum – a layer of reflective tissue behind the retina that bounces the light back a second time, magnifying its intensity.

There's also the colour of its 'pecking spot', located at the tip of the beak and serving as a guide for chicks begging to be fed. In most gull species this is bright red or yellow, but in the swallow-tailed, it's white. For a species that returns to the nest under cover of darkness with its catch, paler markings are much easier to see.

EARLIER RESEARCH HAS ALSO reported certain features that, at the time, were not necessarily seen as relating to hunting technique – for example, the bird's buoyant flight. Compared to other gull species, the swallow-tailed's wings, particularly its primary feathers, are longer and highly flexible, as is its widely fanning tail. These features provide exceptional manoeuvrability in mid-air, an obvious asset when snapping at squid that skip only briefly out of the water.

Occasionally, when I've used a torch on a boat at night, hunting gulls have flown into the beam, revealing entire undersides in a remarkably reflective white. Watching squid leap from the water and the birds in hot pursuit, I couldn't help but wonder if those flashing white wings, even when illuminated only by stars, could be sufficiently disruptive to flush prey into the air.

The gull's eyes reflect light behind the retina, which helps it to see dimly lit objects

The striking birds are the only gulls to have deeply forked tails

> "Anyone who simply thinks of gulls as those pesky sandwich-robbers is sorely mistaken"

Finally, there is that strange crackling call, something between a rattle and a creak. Intriguingly, it reminds me of the sound that dolphins make underwater. Could it be that the swallow-tailed gull, along with all its other unique characteristics, is also the only seabird to somehow use echolocation to detect its airborne prey? While echolocation – in which an animal can 'visualise' its surroundings by interpreting a sound as it bounces off surfaces such as the sea – is a widespread navigational tool among bats, it is rare in the avian world, known only from cave-nesting oilbirds in the South American rainforest and some swiftlets, who likewise inhabit dark caverns.

Sebastián Cruz recently embarked on a new study using tiny sound recorders temporarily attached to the hunting gulls. Originally sceptical about the possibility of seabird echolocation, he was excited to discover that the swallow-tailed gull emits at least two types of click pattern – a simple volley and a complex burst.

THE REGULAR VOLLEYS SEEM to correspond to some form of echolocation, while the rapid-fire bursts are more typically associated with a focused 'read' of a moving object. The latter may be connected to those squid-chasing episodes that I myself have witnessed, though of course we can't be sure.

Next on Sebastián's agenda is an expedition at sea, recording the bird's vocalisations while using only infra-red cameras to rule out the potential effect of a ship's lights, which have been a factor during my own observations. I'm excited to see what more his team will learn about the hunting adaptations of this enigmatic bird.

There are more than 50 species of gulls worldwide, from the Arctic to the Antarctic, and from the high Andes mountains to the open seas. Anyone who simply thinks of 'seagulls' (a misnomer, as they are collectively called gulls, not seagulls) as those raucous and pesky sandwich-robbers at a beach picnic is sorely mistaken. None could be further from that characterisation than the mysterious, elegant swallow-tailed gull – which is, at last, starting to give up some of its secrets.

COSTING THE

Elmley National Nature Reserve on the Isle of Sheppey in Kent is a gigantic feeding table for waders and wildfowl

REDSHANK ON MARSHLAND: JODIE RANDALL/RSPB-IMAGES.COM

EARTH

We need to restore nature and rewild the world. But who will foot the bill?

Words by **JAMES FAIR**

THE FIELDS AT SLEIGHT FARM, near Bath, are not much to look at. One is bare earth and deeply rutted, reminiscent of land that has been subjected to the rootling behaviour of wild boar. “This,” says environmental consultant Dominic Woodfield, “was the most rubbish. Overgrazed and compacted, and it’s had fertilisers, too.”

To start the process of ecological recovery, Woodfield, site manager Simon Nash and farm manager James Fowles introduced a couple of Tamworth pigs to the field. The pigs’ rootling behaviour creates ruts and exposes the soil, giving seeds other than grass the chance to germinate.

Exactly what happens next, the team isn’t really sure, but the action of the pigs should be a kickstart, precipitating natural processes that can bring the field back to life. In time, one can imagine it supporting nesting skylarks, vole-hunting barn owls and the occasional mad March hare.

This field is a perfect example of why the UK ranks in the bottom 10 per cent of all countries in the Biodiversity Intactness Index – but it is also on the frontline of a revolution. Because the transformation being plotted at Sleight Farm isn’t born purely out of altruism, nor from government subsidy, but because the landowners have received money from a developer.

There is arguably no more existential question for the human race than how we halt and reverse declines in wildlife. There is a basic premise that if we destroy nature, we destroy ourselves, because we rely on it for so much – food, water, protection from flooding and mitigation of climate change.

It was once thought the solution was a question of raising awareness – through, for example, wildlife documentaries. Then there was hope that governments would sort things out through international agreements, and, to a certain extent, they did. The Rio Conference on biodiversity in 1992 and the Paris Agreement of 2015 were both hailed as game-changers at the time. Yet none of this seems to have worked.

In the past decade or so, a potential new saviour has emerged. Somewhat alarmingly,

ABOUT THE AUTHOR

James Fair is a wildlife journalist with a specialism in conservation and controversial issues. Read more about his work at jamesfairwildlife.co.uk.

Tamworth pigs turn over turf in search of roots, bringing a range of benefits to their habitat

> “If the private sector doesn’t have to spend money enhancing wildlife, then it probably won’t”

perhaps, it’s the very same entity that has arguably played the biggest role in wreaking environmental destruction in the first place: the private sector. Companies. Investors. Pension funds.

But this new funding model for nature has not taken off either – not yet, anyway. Take the UN’s REDD+ programme, which aims to help developing countries maintain carbon-rich tropical forests by paying them not to chop them down. It was initially funded by international governments but, as long as a decade ago, it was hoped that the private sector would step in and take on more of that burden.

Sadly that hasn’t happened. And after all, if the private sector doesn’t have to contribute, then why should it? Some big companies like to demonstrate they are environmentally responsible by contributing to, for instance, voluntary carbon offsetting schemes (including those under the REDD+ umbrella). The problem with such schemes is that they are often accused of being little more than greenwashing: in general, the money paid is a tiny percentage of turnover, and the schemes themselves often achieve only marginal benefits for the environment.

But in England, there is now a policy that requires developers to compensate for the nature lost to their development. It’s called Biodiversity Net Gain (BNG), and became mandatory in 2024.

BNG IS COMPLEX BUT THE legislation essentially requires developers to assess how much wildlife is on the land they are building on, in the form of biodiversity units. They then either recreate the same number of units, plus 10 per cent, on-site or pay for enhancement or restoration of nature elsewhere.

While BNG is being forced on developers, some business people see

Cley and Salthouse Marshes on the north Norfolk coast are home to more than 300 resident bird species

it as an opportunity. Take brothers Philip and Andy Brainin, owners of the aforementioned Sleight Farm and cofounders of Biofarm, a company that helps both landowners and private companies with BNG deals.

"Working in BNG appealed because it addressed three big issues," says Andy Brainin. "Climate and nature being in a disastrous state; the need to build more housing without harming nature; and farming becoming unviable for landowners."

The Brainins are creating 'habitat banks' – essentially, parcels of enhanced nature – and selling the resulting biodiversity units to companies in need.

Given the government's target to build 300,000 homes a year, it's estimated that, annually, BNG could result in the enhancement or restoration of 15,000ha of new wildlife habitat and drive £135–270 million into conservation. Or, at least, those *were* the figures. Labour recently announced it could ease or drop BNG requirements for small and medium-sized house-builders, which could nearly halve the amount of money going towards conservation.

And that is perhaps the biggest weakness of the policy: again, if the private sector doesn't have to spend money enhancing wildlife, it probably won't. It's also not clear how the proposed Planning and Infrastructure Bill (see our Special Report, August issue) will impact the new policy.

But what if you could persuade private-sector companies that safeguarding biodiversity was in their interest, rather than something being foisted upon them? That's the concept that Rebalance Earth, a 'boutique fund manager', is working on.

Here's how it works: pension funds need to invest clients' money in something that will provide a return. That could be companies listed on the stock market or government bonds.

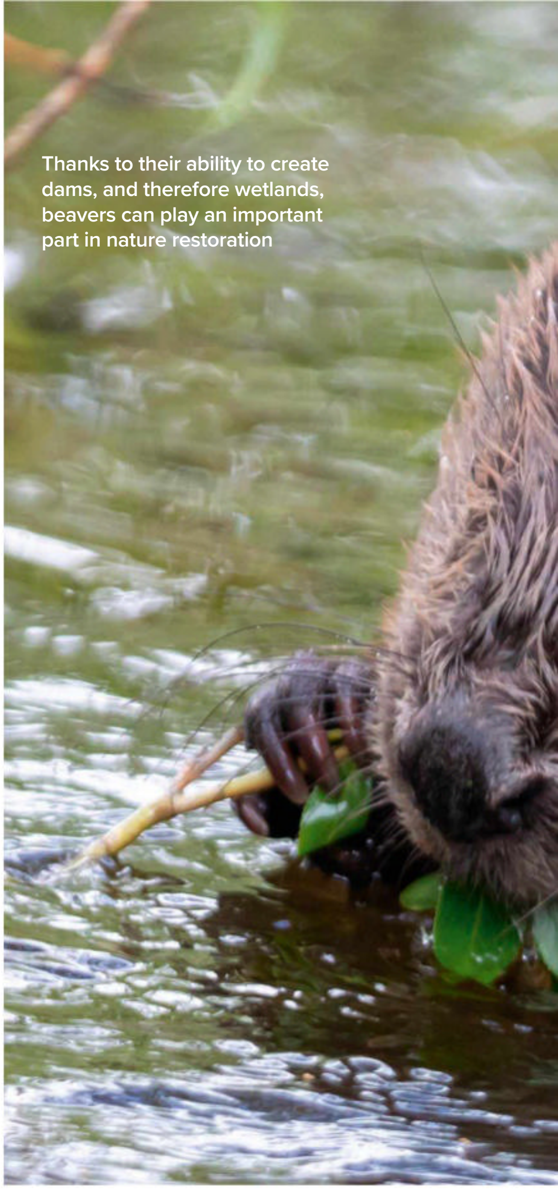
Managing director Robert Gardner believes Rebalance Earth can provide a return by investing in nature, because the private sector is increasingly impacted by natural events such as flooding. "Network Rail and the Highways Agency think a third of their railways and roads are at risk from flooding, and that will increase to 50 per cent in the next 25 years," he says.

Flooding also affects water companies, whose creaking infrastructure is less and less able to cope with heavy downpours. And what if electrical substations or supermarkets were to flood? A report from Oxford University has predicted that 12 per cent of our Gross Domestic Product (GDP) is at risk from climate-related issues.

Gardner puts that in perspective: "At the peak of the Covid lockdown, there was an

TAMWORTH PIGS: STEPHEN DALTON/NATUREPL.COM;
MARSHES: DAVID TIPLING/NATUREPL.COM

Straightened rivers can be rewiggled to restore habitats



Thanks to their ability to create dams, and therefore wetlands, beavers can play an important part in nature restoration

“People are cynical about being able to make money out of nature – there’s a huge cultural problem with that”

11 per cent drop in GDP, and that was very short and sharp,” he says. In other words, if that was bad, the damage from climate-related events could be far worse.

But there are solutions. “We identify where there’s material financial pain [to the private sector] and then identify the nature-based solutions that offer valuable ecosystem services,” says Gardner.

“We then go to the supermarkets, airports and water companies, and say, ‘If we reduce your flood risk by 80 per cent, if we help unlock £2 billion worth of development capital, you need to pay us for that.’”

These solutions could be restoring peat or planting trees in upper catchments, rewiggling rivers or returning beavers to a wetland, and thus increasing its water storage capacity. Rebalance Earth is talking to the private sector about funding river and peatland restoration, and will this year launch a £150 million exemplar fund.

A total of £5 trillion is invested by pension funds in the UK and this will double to £10 trillion by 2035. If just 2 per cent of that £5 trillion were invested in nature, Gardner argues, that’s £100 billion, which would go a long way.

As noted earlier, carbon offsetting has acquired a dubious reputation. In the UK at least, that could be changing. Here, some companies are willingly investing in carbon credits up to five times the cost of those in larger schemes in Africa or Asia.

Engineering consultancy Arup, for example, has bought 10,000 tonnes of carbon credits (at £100 a tonne) as a voluntary offset for its own emissions. It purchased these from Nattergal, a nature restoration company that aims to generate a return from rewilding projects.

Carbon credits are different to biodiversity units under BNG, because you are literally just paying for someone to sequester carbon on their land – but, done properly, they can have a positive impact for wildlife, too.

Nattergal deals in biodiversity units as well as carbon credits. With investment from a partner, it has bought what chief commercial officer Claire Traynor describes as three “degraded arable farms”. By introducing moderate interventions (deer fences, for example) and using natural processes, it is restoring wildlife to these farms and, like the Brainin brothers, selling the ensuing units to developers needing to meet BNG obligations.

Nattergal has so far secured 1,700 biodiversity units (on about 1,000ha) that can be sold. “Entry-level units come in at £25,000–£28,000,” says Traynor, “and range up to, say, a water course unit,

In numbers

£800

The minimum cost of creating 1ha of meadow. It can go up to £6,000, depending on the site.

£2,297

The grant funding available for landowners who create 100m of hedgerow. The same amount is available for a similar length of fencing, if needed.

£30,000

Estimated average cost of a single biodiversity unit – but prices range from £10,000 up to £140,000.

£1.8bn

The amount of money needed every year to restore nature in the UK, though some estimates suggest the figure is closer to £6bn. Current spending is around £500m.

£542bn

What the UN says we will need to spend annually on nature restoration by 2030. Current spending is around £150bn.

which is complex to deliver and comes in at £120,000–£140,000.” Nattergal is also looking at how it can ‘sell’ the natural flood management properties of restored land to, for example, insurance companies.

These projects can be a challenge, though, and Julian Matthews knows this all too well. In 2021, he founded the Real Wild Estates Company. As with Nattergal and Biofarm, the idea was to leverage money for nature restoration from the private sector. But the company folded last year.

Floods damage ecosystems and are costly to businesses

“We knew it was going to be tough. We were pioneers – the first people to really monetise [nature] for landowners,” says Matthews. “People are cynical about being able to make money out of nature – there’s a huge cultural problem with that.”

He argues that part of the issue, in the UK at least, is lack of scale. Companies looking to invest in carbon credits don’t want estates of hundreds of hectares, they’re looking for landscapes comprising hundreds of thousands of hectares. “In the same way, a banker is going to get out of bed for £10 million, not £10,” he points out.

For all the optimism around the private financing of nature restoration, there are still huge question marks over whether it will ever come to anything. A report by Bloomberg found that of $208 billion directed towards nature conservation in 2023, $165 billion (79 per cent) came from the public sector.

And though the biodiversity offsets market – schemes such as England’s BNG programme – is expected to reach $160 billion by 2030, that is still a fraction of the $1.15 trillion (five times the current figure) that experts say is needed to stop further declines in nature.

BACK AT SLEIGHT FARM, ANDY and Philip Brainin are being shown the progress so far. The hedges are blousy with flowering blackthorn, and Woodfield and Nash discuss rewetting the lower field, which could possibly attract wetland birds such as snipe.

Time will tell, but I can’t wait to visit Sleight Farm in five or 10 years’ time, because I have a feeling that it will be something very special. The jury is out, however, on whether private finance – through BNG or carbon credits, or via flood alleviation or mitigating other natural impacts – is likely to have had a significant effect in the rest of the country, or indeed the world, in that time.

But there is also a sense that private finance could be one of our last hopes.

EDDLESTON WATER: SCOTLAND – THE BIG PICTURE/NATUREPL.COM; BEAVER: IAN SHERRATT/ALAMY; FLOOD DAMAGE: OLI SCARFF/GETTY

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What is a pseudo-thumb?

When it comes to climbing and grasping objects, it's easy to see how being thumbless might be a hindrance. While true thumbs are specialised finger bones, some animals have evolved thumbs from their wrist bones. These are called pseudo-thumbs and are essentially a sixth digit.

Giant pandas evolved pseudo-thumbs to accompany their thumbless, five-fingered paws when they made the switch from meat-eating to a largely plant-based diet. It is thought that pseudo-thumbs help giant pandas hold bamboo.

Red pandas, which are more closely related to raccoons than to giant pandas, independently evolved pseudo-thumbs, initially to help them climb. Aye-ayes, a species of lemur that is native to Madagascar, evolved pseudo-thumbs for the same reason.

The evolution of thumbs and pseudo-thumbs is an example of convergent evolution. This is when different species, faced with similar environmental challenges, independently evolve similar ways to solve those challenges – with another example being the evolution of wings in birds and bats.

The evolution of all these thumbs is one of the most striking examples of convergent evolution in the natural world, and the fact that they have evolved in multiple species just goes to show how handy thumbs really are. **Beki Hooper**

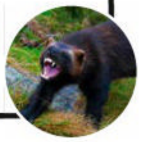
Giant pandas devour up to 38kg of bamboo daily, eating stems, leaves and shoots

PANDA: SUZI ESZTERHAS/NATUREPL.COM

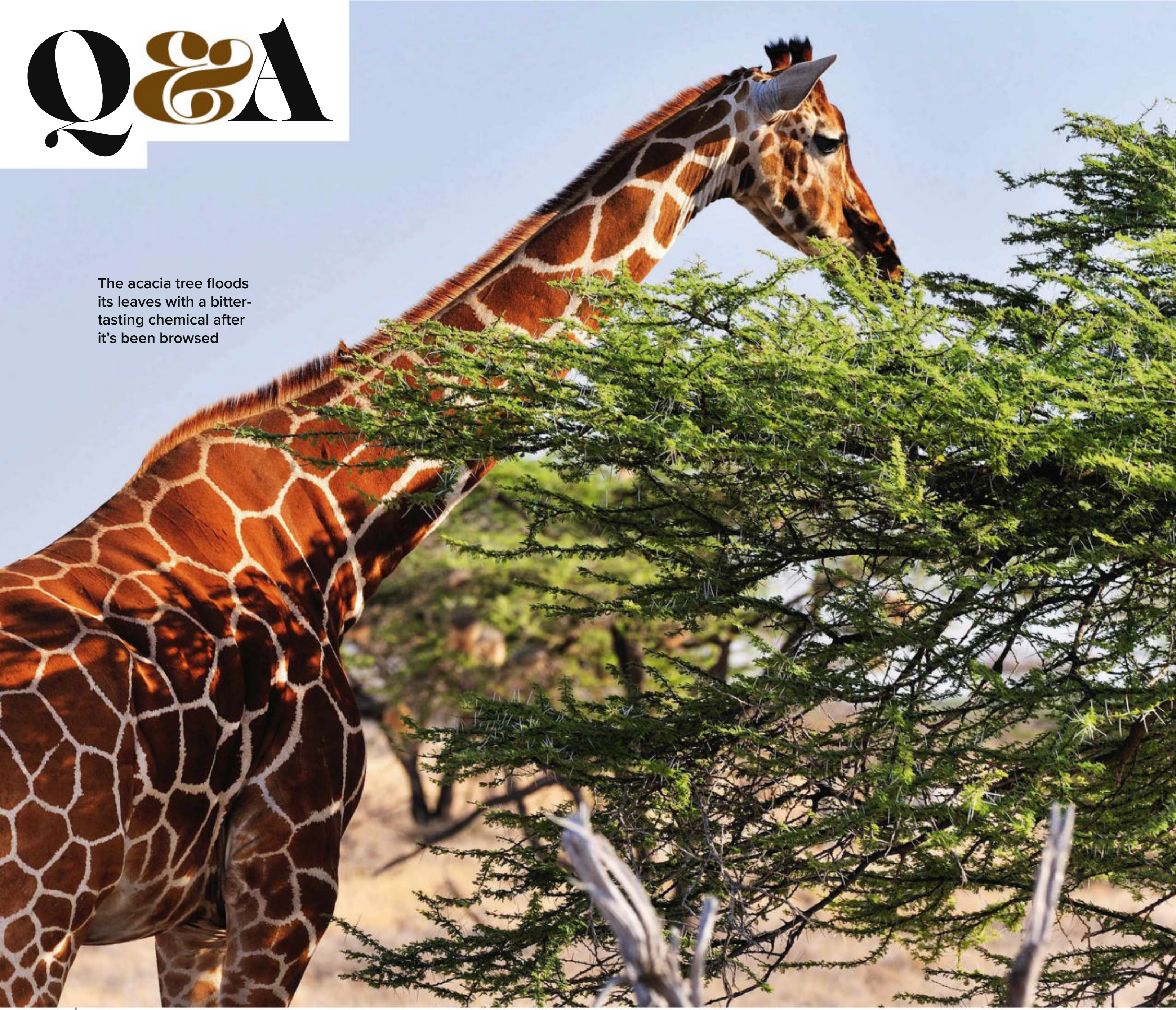
GRASS ROOTS
Are plants capable of memory or communicating information? **p82**

IN THE CROWD
Whether it's a flock, swarm or herd, what is the largest animal gathering? **p85**

CLAWS OUT
This formidable mustelid can crush bone and eat meat that's frozen solid **p88**



Q&A



The acacia tree floods its leaves with a bitter-tasting chemical after it's been browsed

Do plants have memory?

To have true memory an organism requires brain cells to store experiences through the action of sophisticated neurotransmitters. Plants lacking brain cells therefore cannot be said to have that capacity for memory. However, there is evidence that some plants adapt their characteristics based on 'remembered' experiences.

From 2015 to 2019, a team of scientists in South Africa studied perennial savannah grasses that had a proven resilience to wildfires. Though they appeared to be destroyed by the flames, their roots were capable of regrowing quite quickly.

The researchers wanted to discover the long-term effects frequent wildfires have on burnt grasses, compared to those never experiencing fire. They studied grass plants on established experimental burn plots, set up in 1980 by the University of Fort Hare to assess whether controlled burning of savannah areas could restrict tree and shrub heights to benefit browsing livestock. They also took plants from control plots where no burning had occurred in those 35 years.

> "Plants adapt characteristics based on past experiences"

After studying the plants' roots and regeneration rates, the team concluded that those repeatedly damaged by flames had developed different characteristics to those that had never had to resist a wildfire. As the study paper says, "Annually burned plants invested more of their biomass below ground compared to no-burn plants, which probably equates to them having greater stored energy reserves to initiate and support early resprouting."

Had the grasses retained a memory of being burned, and so adapted themselves to ensure rapid regeneration after a wildfire? While that theory might assume too many human-like characteristics in a non-sentient life-form, there are various other examples of plants having at least a form of 'memory' encoded in their genes.

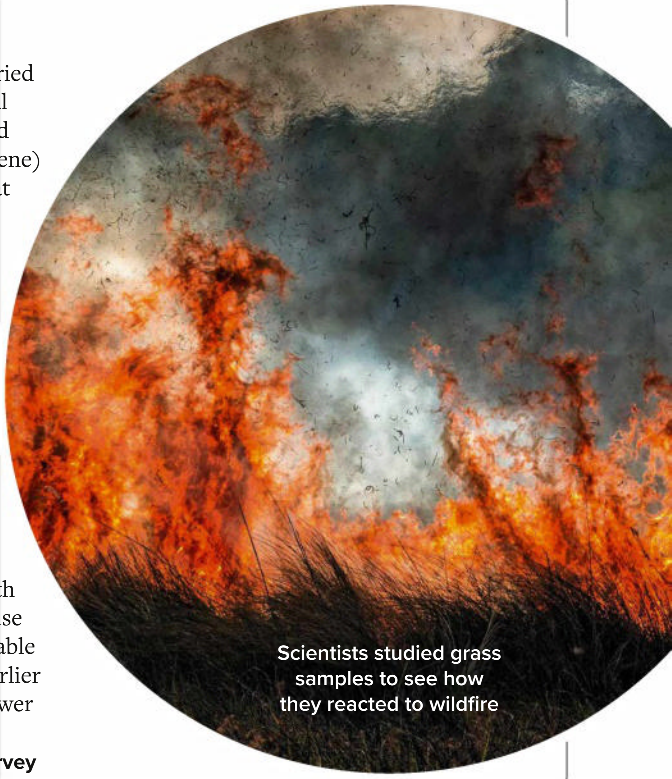
Wouter van Hoven published a study in 1994 after observing acacia trees being browsed by giraffes and antelopes in what was then the Transvaal province in eastern South Africa. Acacia leaves contain low levels of the chemical tannin, which has a bitter taste. As the animals feed, the damaged leaves emit ethylene gas. This is detected by the cell membranes of other acacia trees, which triggers a release of certain proteins. These proteins stimulate the trees' stress-response genes and cause the production of more tannin to flood the leaves and make them unpalatable.

The change happens quickly. "When an intact plant is exposed to the [high levels] of ethylene, the tannin levels increase within 30 minutes," wrote van Hoven. Is this simply an automatic chemical reaction to a sequence of events, unrelated to the cause of the ethylene gas release, or is it a genetic memory telling the tree it is under attack and a defence mechanism is required?

Scientists have a phrase – 'epigenetic changes' – that relates to alterations in the way that DNA instructions are carried out, to reflect damaging environmental conditions. Researchers in Norway (led by Carl Gunnar Fossdal and Paal Krokene) studied Norway spruces and found that epigenetic changes "provide the plant with a 'memory' of past stressful events and may be passed on to their seeds, making the next generation better prepared to face the challenges around them."

"Stressful events may be passed on to their seeds"

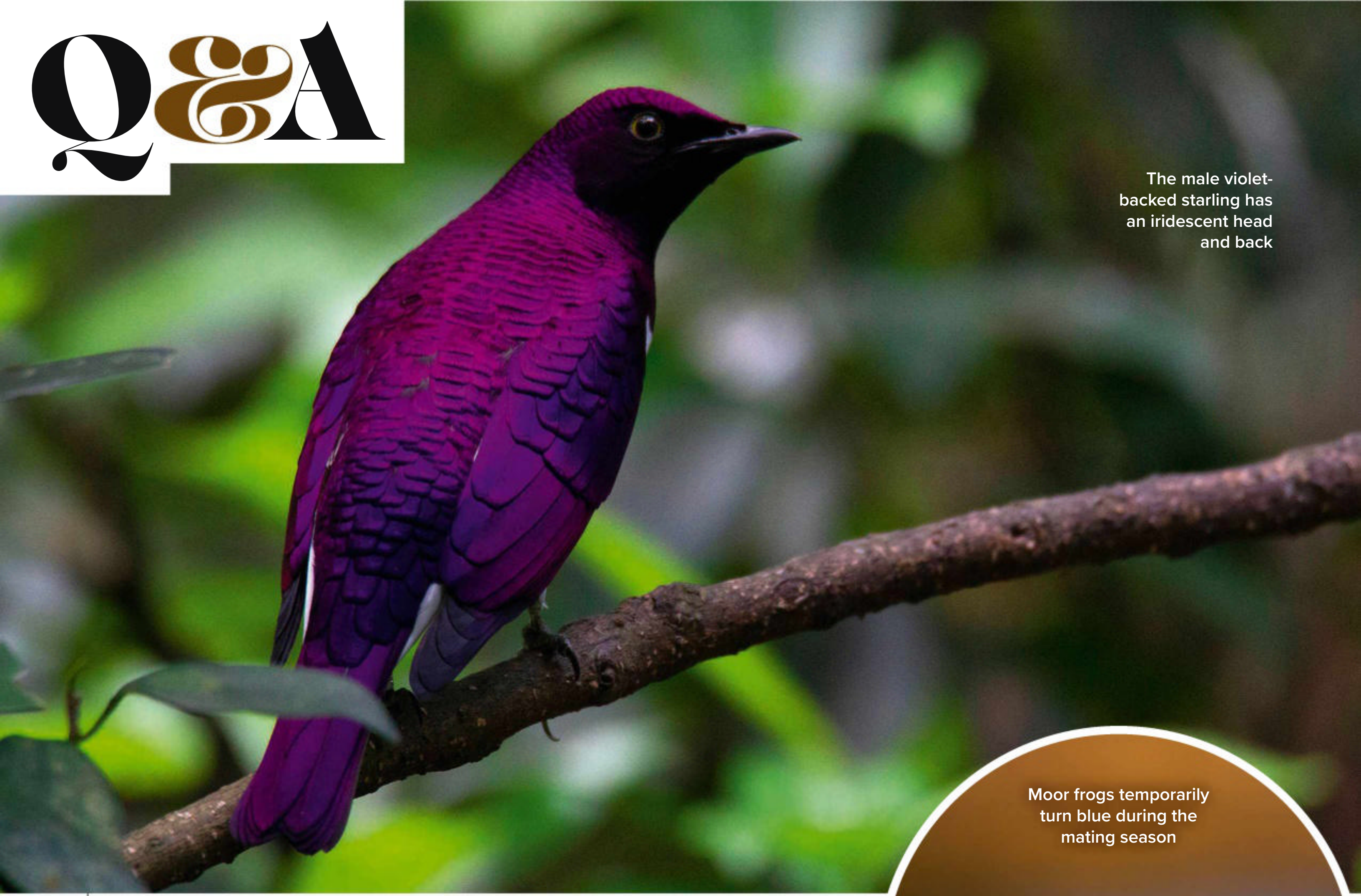
According to the scientists, one environmental signal that can trigger conifer memories is temperature. Summers are shorter and colder the further north the trees grow, so they have to maximise the time their leaves can capture available light. In spring, new needles appear earlier on trees from seeds that grew up in lower temperatures, compared to the same species in warmer regions. **Sheena Harvey**


Scientists studied grass samples to see how they reacted to wildfire

Epigenetic changes are seen in tree species such as the Norway spruce

GIRAFFE: JÜRGEN FEUERER/ZOONAR/ALAMY; FIRE: BERND BIEDER/IMAGEBROKER/ALAMY; NORWAY SPRUCE: PETER HIMMELHUBER/ZOONAR/ALAMY

Q&A



The male violet-backed starling has an iridescent head and back

Moor frogs temporarily turn blue during the mating season

What's the rarest colour found in nature?

While the natural world is bursting with colour, some hues are much rarer than others. This is because of a combination of two factors: evolution and physics. Evolution selects colours that help animals and plants survive and reproduce. But evolution cannot work alone – it functions in partnership with light's physical properties.

In the natural world, colour is either produced through absorption-based pigments or structural colour. Pigments absorb specific wavelengths of light and reflect others. We perceive different wavelengths of light as different colours. The wavelengths that pigments do not absorb are the colours we see. For example, if a pigment absorbs high-energy wavelengths, such as blue, but reflects low-energy ones, such as red, we will see that pigment as red.

Photosynthesis needs high-energy blue light (among other wavelengths) and plants have consequently evolved pigments that absorb, rather than reflect, blue light. The colour blue is therefore quite an unusual sight in the plant world. And because many animals get their pigment through the food-chain, with plants at the bottom of this, blue is relatively rare in animals.

> "Many animals get their pigment via plants"

Unlike pigment-based colours, structural colours are formed by colourless molecular structures that scatter light. This scattering creates an iridescent effect where a range of hues can be observed from different angles (such as the feathers of a magpie or the stunning wings of a blue morpho butterfly).

Colour-scattering structures usually scatter high-energy wavelengths. These are more easily scattered than low-energy ones. So while blue is a rare pigment in nature because high-energy blue light is preferentially absorbed by plants, the same physical property also makes blue one of the most common structural colours. Meanwhile, red – a common pigment – is a rare structural colour because it's low energy, and this light is difficult to scatter.

So considering both pigment and structural colour, what is the rarest colour in nature overall? The answer is violet. The highest-energy wavelength of visible light, violet is very rare as both a pigment and a structural colour. Mammals are unable to create pigments for violet, so you'll only find it in birds, insects and marine species that can display it through structural colour. Violet birds include the purple honeycreeper, violet-backed starling and imperial amazon (a parrot species). When it comes to insects, you'll find purple emperor butterflies, and in the ocean, purple sea stars and purple sea slugs. **Beki Hooper**

STARLING: SAURABH MANDAKNALLI/EPHOTOCORP/ALAMY; FROG: MICHAL FUGLEVIČ/ALAMY

What's the difference between global warming and climate change?

PEOPLE OFTEN USE THE TERMS global warming and climate change interchangeably, but they describe different concepts. Global warming refers to Earth's increasing surface temperature. Our planet's surface temperature has been rising for the past century-and-a-half, with the most significant rise happening from the 1970s to the present. The increase is caused by heat-trapping greenhouse gases, which are released when we burn fossil fuels such as coal.

Climate change refers to changes in Earth's climate at all scales, from local to global, because of human activity. While climate change includes global warming, it also refers to changing weather patterns at a local scale – such as more extreme winter and summer temperatures, intense heatwaves and increased storm frequency – as well as large-scale changes such as melting sea ice and rising sea levels.

Global warming is therefore a more specific term than climate change. While climate change encompasses a wide range of changes at both local and global scales, global warming refers specifically to the rapidly increasing surface temperature of our planet. **Beki Hooper**

Arctic foxes are having to adapt to melting sea ice and warmer temperatures

Do sharks have bones?

Cartilage means sharks can swim faster than bony fish

WHILE HUMANS HAVE A BONY skeleton, parts of our bodies – such as our noses – are made of cartilage. This soft, flexible material forms the entire skeletons of sharks and rays.

We have long known that the ancient ancestors of both bony and cartilaginous animals had skeletons made of cartilage. This means that cartilage was the 'ancestral state' that we all once had.

Scientists once thought that the ancestors of sharks and rays never evolved bone, but one fossil changed that idea. *Minjinia turgenensis* was an ancient jawed fish. It was thought to be an ancestor of both bony and cartilaginous creatures, yet it was bony. This means that sharks and rays probably re-evolved a cartilaginous skeleton from a bony one.

A cartilaginous skeleton is likely to be useful for oceanic predators because it is lightweight. While more constraining than a bony skeleton in terms of the shapes it can support, it allows for quicker swimming, tighter turning circles and better buoyancy. For sharks and rays, at least, cartilage is clearly an excellent adaptation. **Beki Hooper**

ARCTIC FOX: MASTAK80/ALAMY; BLACKTIP SHARK: STEVE WOODS PHOTOGRAPHY/CONNECT IMAGES/ALAMY

What's the largest animal gathering on Earth?

Swarms of desert locusts can decimate crops

People love a party. But as populous as our species is, the headcounts at our gatherings don't match those of other species. The Maha Kumbh Mela, a Hindu pilgrimage in Prayagraj, India, drew more than 660 million people in January 2025. But this horde – thought to be the largest in human history – pales in comparison to the groups formed by our animal relatives.

The largest animal gatherings in the world likely occur in the chilly depths surrounding Antarctica. The Southern Ocean is home to Antarctic krill – tiny crustaceans that form swarms more than 20km long. A single swarm may contain trillions of individuals. Krill are a crucial food source for other organisms, including fish, penguins and whales.

The largest recorded terrestrial gathering is believed to be the so-called Albert's swarm of 1875. Recorded by physician Albert Child, it constituted an estimated 12.5 trillion Rocky Mountain locusts, a now-extinct species of grasshopper. The cloud of insects covered some 512,800km² of the Midwestern USA. Even if Child's methodology for estimating the numbers was likely to be off, locusts do form some of the largest animal gatherings on the planet. A locust plague in East Africa and parts of Asia that lasted from 2019–22 saw swarms of up to 70 billion individuals.

Other animal gatherings are comparatively modest. Vertebrate animals generally reproduce more slowly and thus do not match the astonishing population surges of their spineless relatives. Still, their numbers can be impressive.

> "It contained an estimated 12.5 trillion locusts"

A 482km-long flock of now-extinct passenger pigeons observed in 1866 comprised some 3.5 billion birds. And red-billed queleas, the most numerous species of bird on Earth, form flocks that number in the millions, which earn them the nickname 'feathered locust'.

Schools of Atlantic herring may number in the billions. And while their habits are not well understood, bristlemouths, a group of 32 species of fish in the family Gonostomatidae, are the world's most numerous vertebrate. These bioluminescent fish inhabit the ocean's twilight zone and number up to a quadrillion individuals globally. It's not unreasonable to assume that trillions may school or shoal at once.

It is worth noting that many of these numbers are estimations and extrapolations, and rest on ambiguous semantics. What is a flock or a school, for example? These categories can be as amorphous as the gatherings they define – flocks and schools merge and separate. But the species described do congregate in staggering numbers, however we choose to describe them. **Richard Pallardy**

Red-billed queleas migrate in vast flocks in search of food

DESERT LOCUSTS: XINHUA/ALAMY; RED-BILLED QUELEAS: TONY HEALD/NATUREPL.COM

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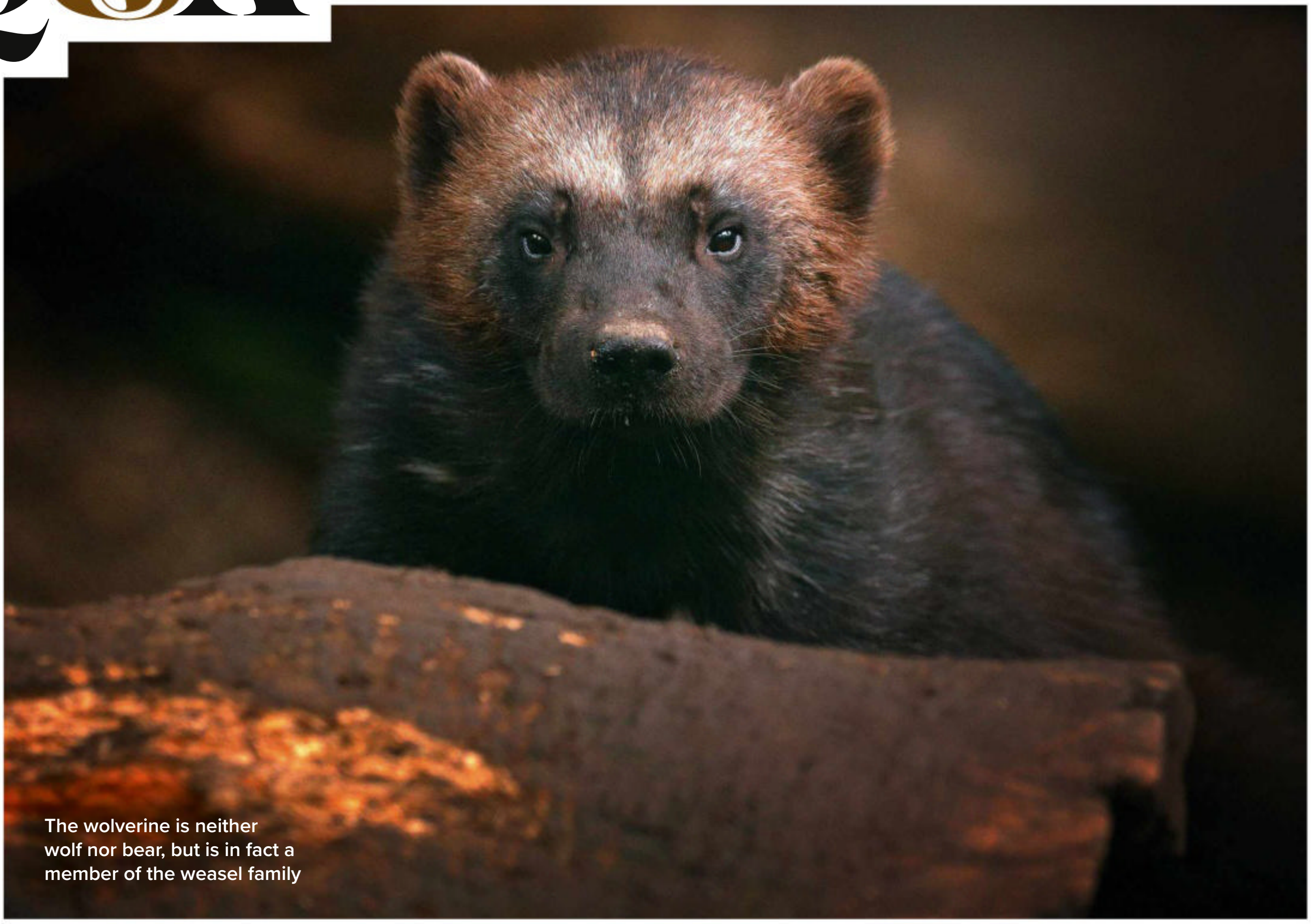


The wolverine is neither wolf nor bear, but is in fact a member of the weasel family

ALL YOU EVER NEEDED TO KNOW ABOUT THE

Wolverine

BY JO CAIRD

For many people, the word 'wolverine' will conjure up the image of a ripped Hollywood superhero, rather than a bear-like creature the size of a dog that lives in the snowy forests, tundra and mountains of the northern hemisphere. But the real-life wolverine is a remarkable creature: a formidable predator, highly territorial and brilliantly adapted to its frigid habitat.

Is a wolverine a wolf or a bear?

Though they look like a cross between the two, wolverines are actually the largest land mustelid, a group that also includes badgers, ferrets, martens, otters and polecats. There are two subspecies of wolverine, the North American and the European, though the differences between the two are genetic rather than aesthetic or behavioural.

Where do wolverines live?

Wolverines can be found across the northern latitudes of Asia, Europe and North America, inhabiting cold, snowy environments that include boreal forests, tundra and mountains. The species used to be found in more southerly areas of Europe and North America, but human activities including hunting and forest clearances have caused a significant contraction of its range.

What's special about their fur?

Their thick fur – which is dark brown with light brown patches going from their shoulders to the base of their tails – is also oily, making it resistant to frost. For this reason, and also because it is very warm, Inuits traditionally used wolverine fur to trim their parkas. As with polar bears, furry feet help the wolverine get around in snowy landscapes.

Do they have retractable claws?

Unlike the Marvel character, wolverine claws are permanently extended, making them extremely useful tools for digging, climbing trees and gripping prey. They're made of a protein called keratin, which is also found in human fingernails.

How aggressive are they?

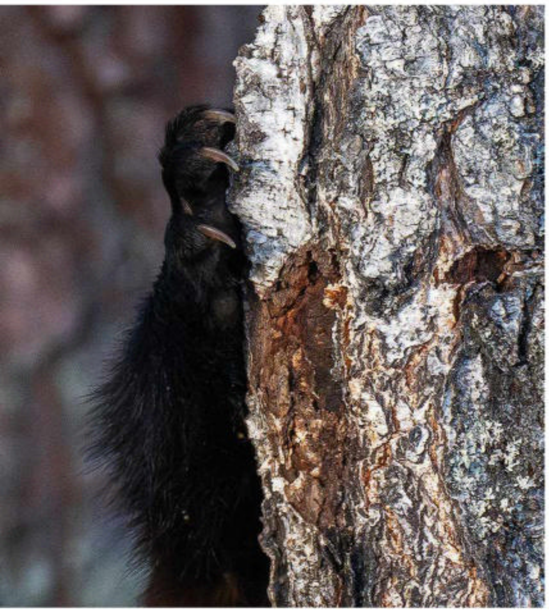
Human interactions with wolverines are extremely rare, owing to the fact that the animals live in remote regions and have very low population density. But it is certainly true to say that wolverines are very effective predators, and bold when it comes to defending their food sources.

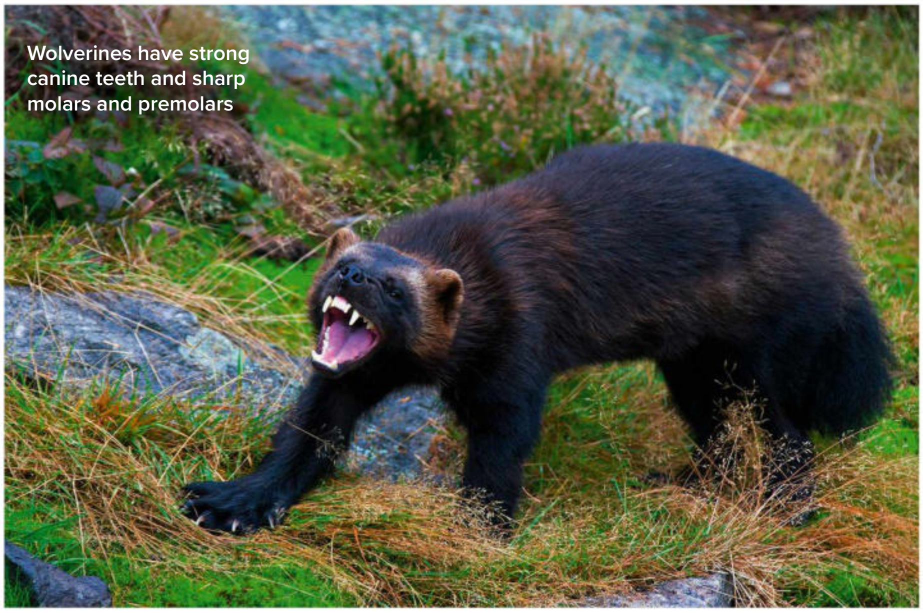
How large is a wolverine's territory?

Wolverines are solitary and fiercely territorial, with each male defending a large territory that includes the smaller territories of several females. A male wolverine might range as far as 24km in a day, marking its turf using oil from a musk gland.

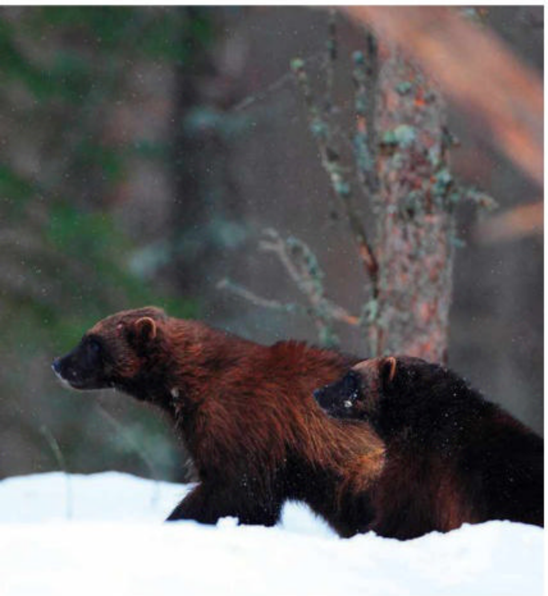
What do wolverines eat?

The wolverine's scientific name, *Gulo gulo*, is Latin for glutton – a reference to the creature's opportunistic, carnivorous diet. In addition to scavenging carrion,





Wolverines have strong canine teeth and sharp molars and premolars



Top: The front feet are equipped with long sharp claws – ideal for climbing trees
Above: A mother and kit. Snow can mean more food resources, such as deer carcasses

wolverines prey on all manner of small birds and mammals, and even hunt much larger creatures, including deer and young or weak caribou. As well as flesh, they consume bone marrow, using their strong jaws and teeth to crunch through bones. They cache their food for later, spraying it with foul-spelling oil from a special gland to keep other animals away.

How are they adapted for their diet?

Wolverines have some of the most powerful jaws of any carnivore in terms of chewing strength, making them capable of crushing bones and meat that has frozen solid. They also have an additional set of premolars compared to other members of their genus – these extra teeth enable them to extract more nutrition from their food.

How do they reproduce?

Wolverines come together only to mate, with mating taking place between April and September. Males typically mate with more than one female per season, while females tend to stick with the same breeding partner from season to season. In order to guarantee that young are born when the female is in good physical condition, that food supplies are plentiful and that environmental conditions are right, embryo implantation can be delayed for up to six months after fertilisation. This process is known as embryonic diapause.

Where do wolverines raise their young?

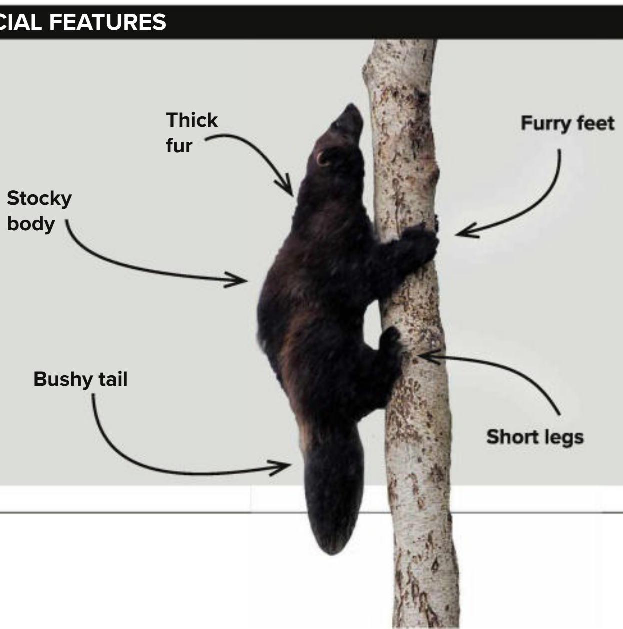
Female wolverines use grass or leaves to build nests for their young in caves or rocky crevices to protect them from predators and the bitter winter chill. They are also known to build dens in deep snow. They give birth to two or three kits between January and April, the family inhabiting the den until May. Dens are found at high-altitude locations, where the snow will last until spring, enabling the mother to keep food cached for her young until they are old enough to forage for themselves. Kits are weaned at around three months old, begin foraging by themselves at around six months old, and reach sexual maturity at two to three years old.

What threats do they face?

The IUCN lists the wolverine as a species of Least Concern. In the USA though, it is listed as Threatened under the Endangered Species Act, owing to the impacts of climate change on its habitat.

A WOLVERINE'S SPECIAL FEATURES

Scientific name: *Gulo gulo*
Family: Mustelidae
Size: 65–145cm long (plus another 13–26cm for tail)
Weight: Females 6–12kg, males 11–18kg
Lifespan: 5–13 years
Habitat: Arctic and subarctic regions of North America, Europe and Asia
Size of territory: 250–1,500km^2



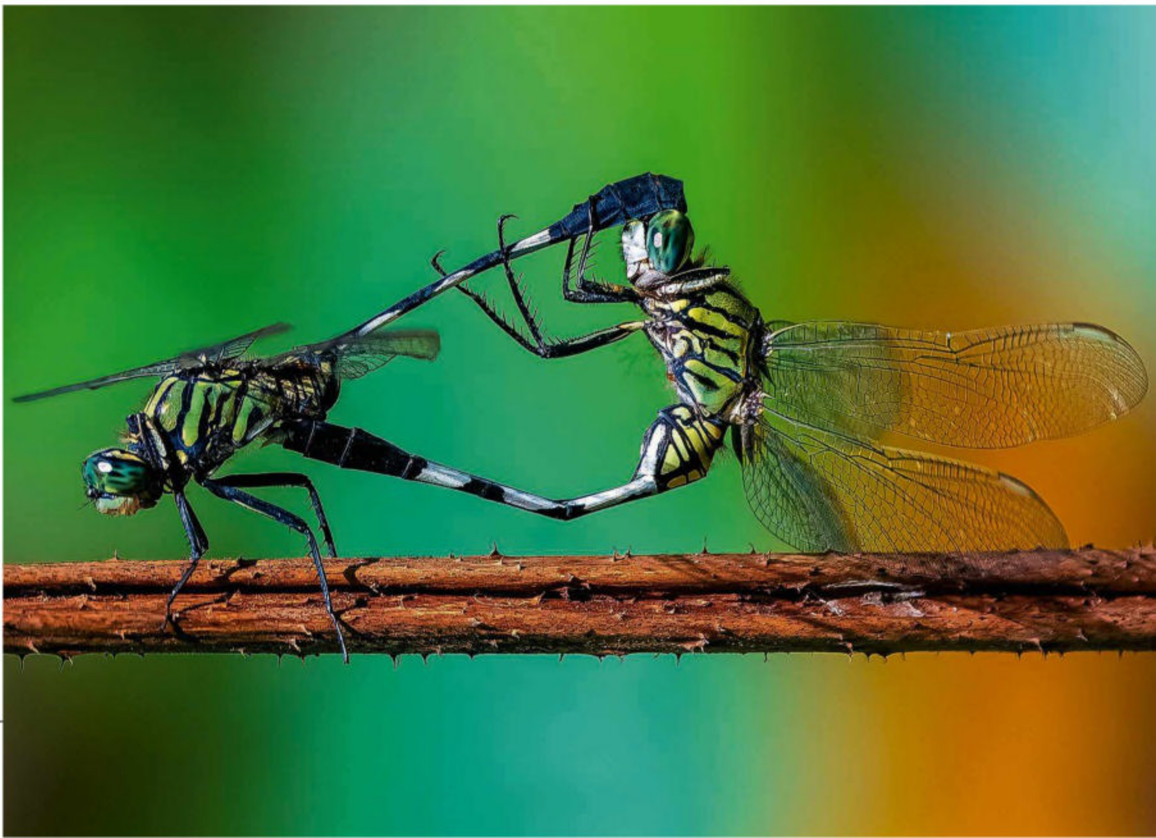
NEXT MONTH

TARANTULA HAWK
The wasp that preys on spiders

WOLVERINE PORTRAIT: ONDREJ PROSICKY/IMAGEBROKER/ALAMY; PAW ON TREE: STAFFAN WIDSTRAND/NATUREPL.COM; WOLVERINES IN SNOW: CHRISTOPHE PERELLE/BIOSPHOTO/ALAMY; WOLVERINE SHOWING TEETH: ARNDT SVEN-ERIK/ARTERRA PICTURE LIBRARY/ALAMY; CUTOUT: SYLVAIN CORDIER/NATUREPL.COM; TARANTULA HAWK: TONIA GRAVES/ALAMY

A rare treat

Seeing the endangered and reclusive red panda has been high on my bucket list for an excruciatingly long time, so this was a dream-come-true moment on a visit to Nepal.
Hari Kumar Prasannakumar, Edinburgh



Spot the difference

Many damselfly species are sexually dimorphic: males are brightly coloured and distinctive; females are plainer. But that doesn't seem to apply to this mating pair.
Sifat Sharker, Dhaka, Bangladesh

SHARE!

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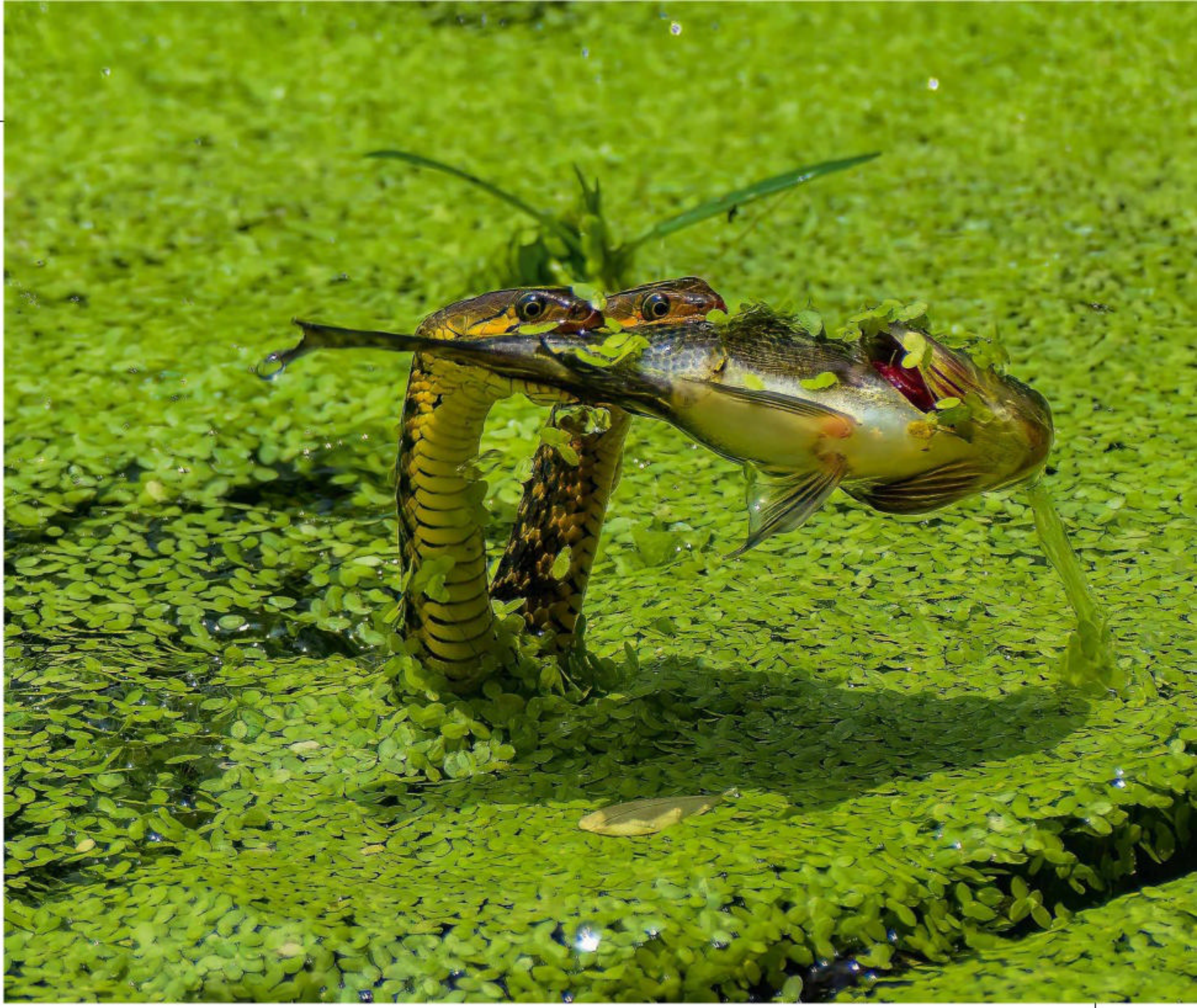
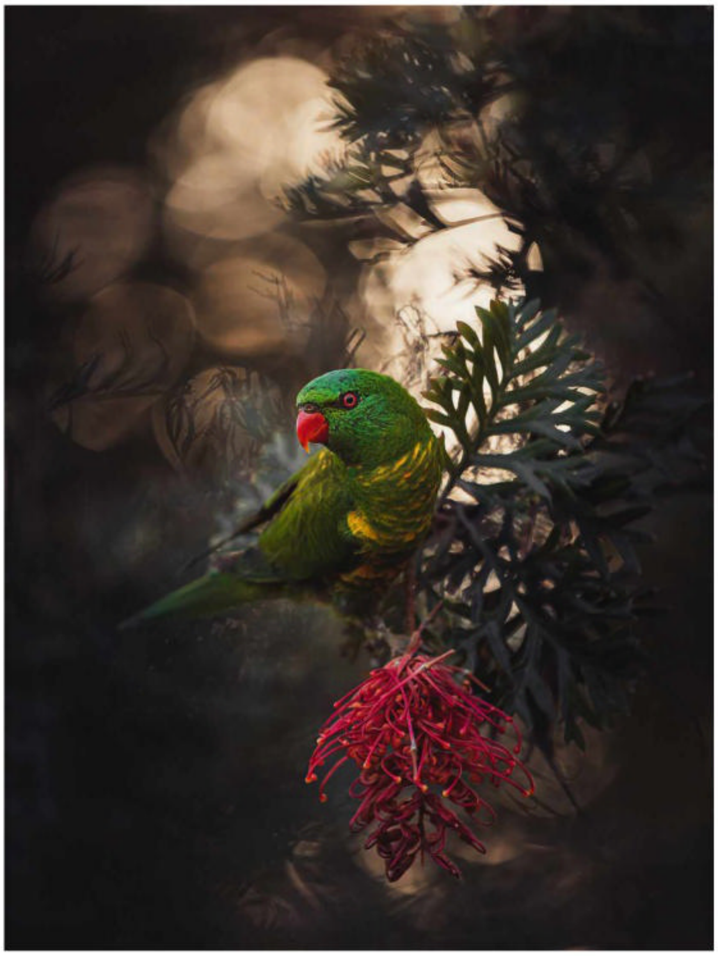
Teamwork

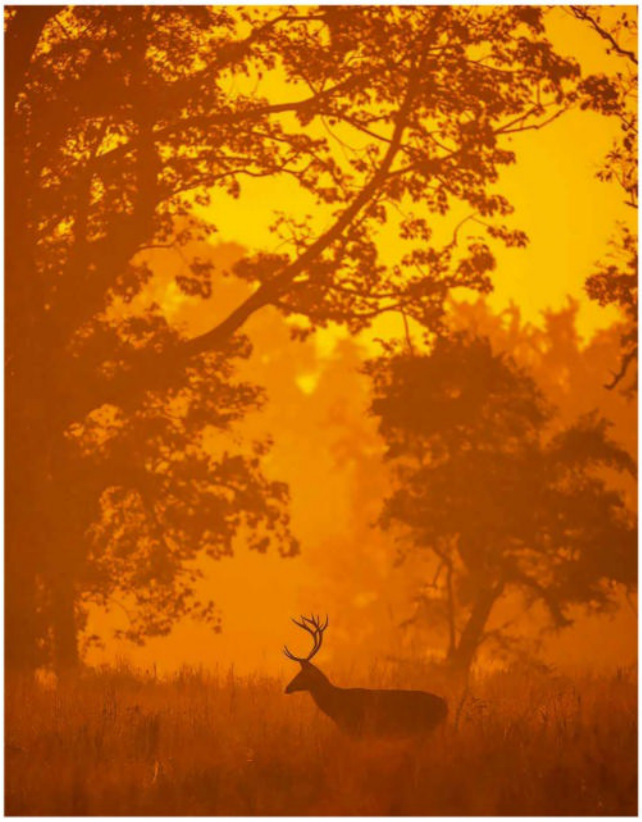
I was taking photos of the birdlife at a temple's pond when I spotted these baby checkered keelback snakes, swimming with their catch of the day.
Sajib Kumar Singha, Sylhet, Bangladesh



A riot of colour

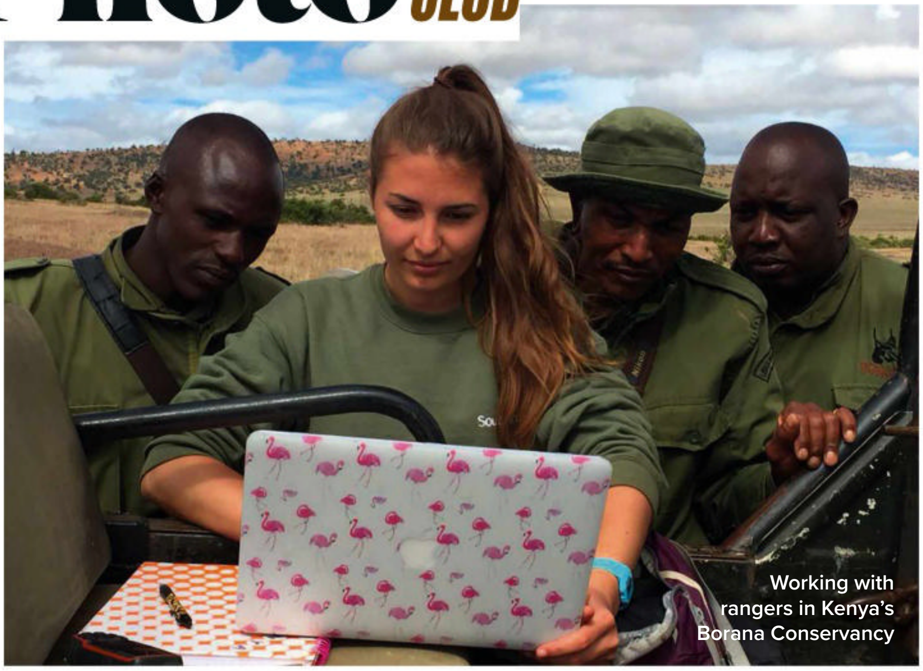
The grevillea is a perfect foil for this vivid scaly-breasted lorikeet, spotted in New South Wales, Australia. In the warm afternoon light, its 'scales' really shimmered.
Daniel Martin, London





Going for gold

Conservation at Kanha National Park in India, known for its golden hour, has helped to protect the swamp deer (or barasingha).
Sumon Das, Kolkata, India



Working with rangers in Kenya's Borana Conservancy

SNAP-CHAT

THE INSIDE WORLD OF WILDLIFE PHOTOGRAPHY

Lara Jackson talks magical otters, curious rhinos and ticks in the toes

How did your career start?

I'm a wildlife biologist, and was fortunate to visit some incredible places as part of my university studies. I wanted to show my family the amazing wildlife I saw, so I bought a bridge camera after a trip to Madagascar, and there began my accidental journey into wildlife photography.

Which of your photographs is most significant to you?

I captured a lioness just after she'd brought down a wildebeest in the Serengeti. As she began to eat, she looked up at me for a split second – her muzzle was absolutely covered in blood. This image kickstarted my career as a wildlife photographer, after it was awarded in the 2021 Wildlife Photographer of the Year competition. It's a powerful reminder of the beauty and brutality of nature.

What's your most memorable shoot?

I had the opportunity to document the Serengeti National Park at the height of the pandemic. The halt in international travel had devastating effects for conservation, which often relies heavily on the funds generated by tourism. Being in the only car in the Serengeti National Park during July, when the wildebeest migration happens, was completely surreal. It will probably never happen again and it's a memory I will treasure forever.

What's your favourite species to snap?

I live on the Isle of Mull and will never get bored of photographing otters. Getting into a position to create a unique image requires an excellent understanding of their behaviour and fantastic fieldcraft. Plus, there's always something interesting happening on the loch shores, and the moody and unpredictable weather can also add an edge. The photo opportunities are endless.

Ready for the chill on a shoot in Norway

Have you had any close calls?

I'm proud to say I've never had a bad encounter. I will always choose to miss a photo opportunity if there's a chance that my presence could negatively impact a wild animal. But while in Kenya, I had one awe-inspiring close encounter. My research partner and I discovered three white rhinos grazing on top of a hill one sunny morning. We were parked about 200m away, and got out of the car to survey the area. I sat down next to the car and began taking photos, getting completely lost in the moment – and before I knew it, the rhinos had wandered over to us. I looked up to see a rhino bull staring at me from about five metres away. Our eyes connected. Heart beating, I held my breath and sat completely still until he let out a huff and walked away.

What's the worst physical discomfort you've had to endure on a shoot?

In Kenya, I accidentally walked through a nest of pepper ticks in long grass. They were so minuscule that they crawled through my socks, and I spent the next few hours picking hundreds of ticks out of my toes and feet. The bites were horrendously itchy for weeks.

Which species is top of your bucket list?

I would love to photograph orangutans. Their expressions and eyes are so human and it's a species that's intrigued me since I was a little girl. Their habitats are vanishing heartbreakingly quickly and I hope that one day, I have the opportunity to observe and capture them in their rainforest home.

What item would you not be without?

Aside from my Nikon Z9 and all my fantastic lenses, I wouldn't be without a good pair of binoculars. You have to find the wildlife before you can photograph it. I also never go on an expedition without taking a jar of Marmite... I can't be without it!

Any top tips for budding photographers?

It sounds a cliché, but practise as much as you can and don't be afraid to make mistakes, as that's how you learn. Try to understand and learn the behaviours of your target subjects. Follow lots of different photographers – the more images and techniques you're exposed to, the more it will help to spark your own creativity and technical prowess.

Lara is a wildlife photographer from Scotland. See more of her work at larawildlife.co.uk

PORTRAITS: LARA JACKSON

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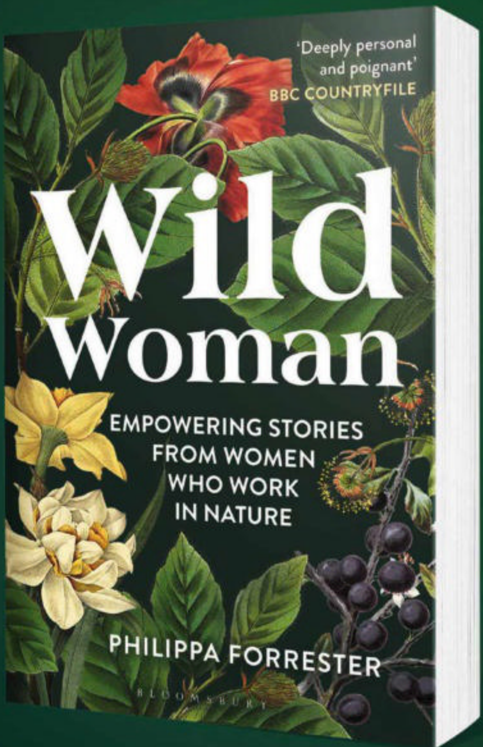
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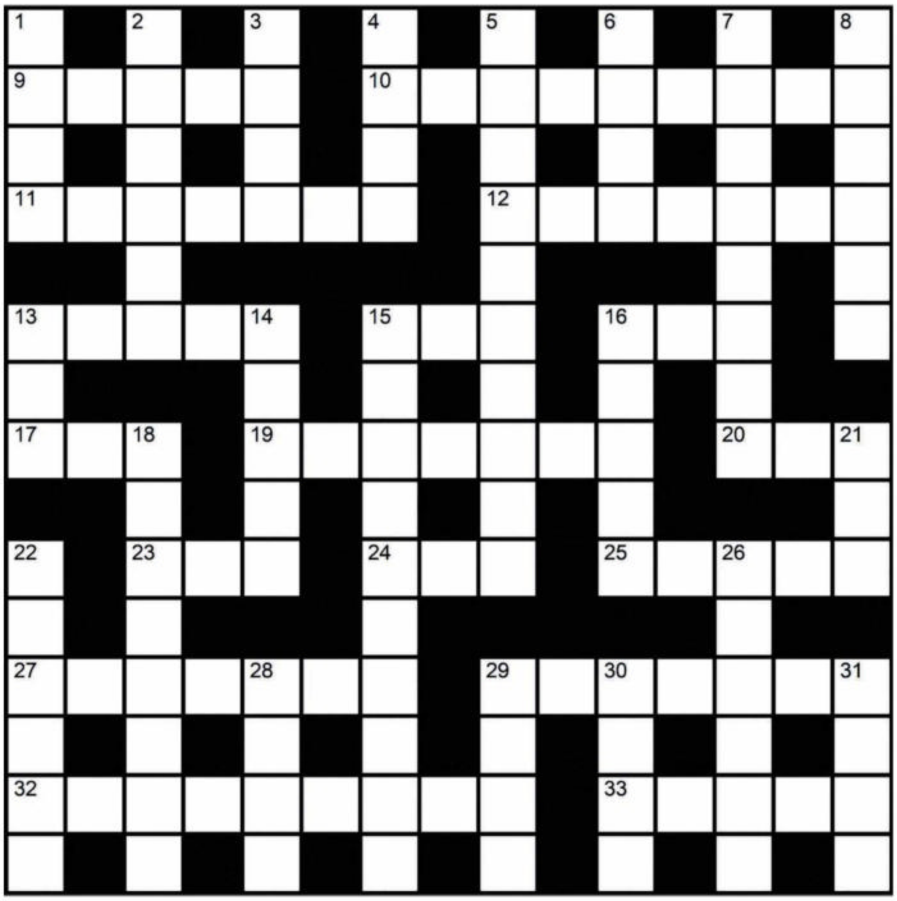
The crossword



ACROSS
9 Groom plumage (5)
10 Parasite that lays nits (4,5)
11 Bird of South America that might be red-legged or black-legged (7)
12 Plant used to produce pigments (7)
13 Raptor's claw (5)
15 Horizontal stripe, particularly on plumage (3)
16 Baby bear, perhaps (3)
17 Foot digit (3)
19 South American country noted for its savannah habitats (7)
20 ___ owl, small bird of Central and North America (3)
23 Wildebeest (3)
24 Female deer (3)
25 ___ Island, part of St Vincent and the Grenadines, home to an endemic gecko (5)
27 Sea-dwelling (7)
29 Scavenging raptor such as the lammergeier (7)
32 ___ sea turtle, large, highly endangered marine reptile (9)
33 An animal's geographic distribution (5)

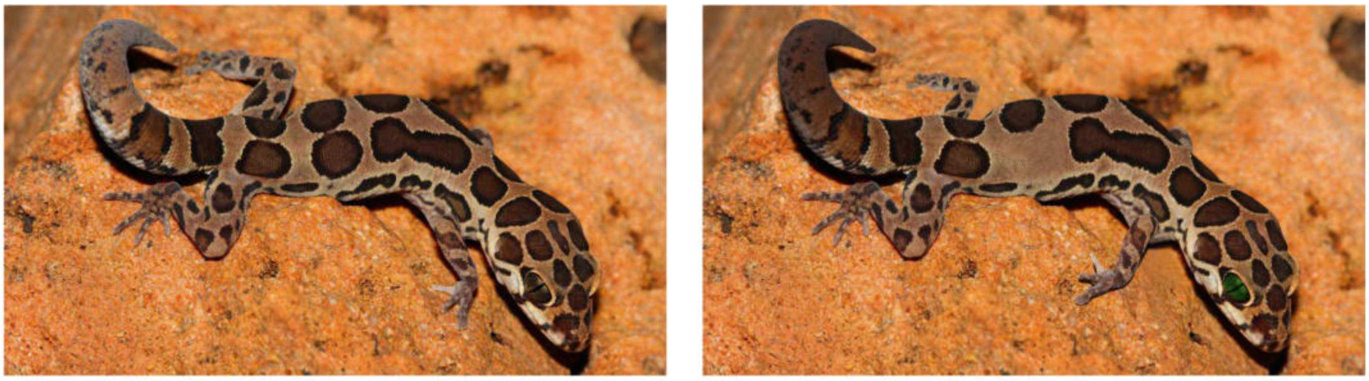
DOWN
1 Chimpanzees, for instance (4)
2 Tubenosed seabird (6)
3 Leg joint (4)
4 Big, flightless bird of South America (4)
5 Ground-dwelling bird of open country in Africa and Asia (10)
6 ___ whale, largest animal in existence (4)
7 Hive matriarch (5,3)
8 Himalayan cedar (6)
13 Small songbird that might be blue, crested or coal (3)
14 Pacific island, ecologically damaged by phosphate mining (5)
15 South American songbird also known as the turquoise honeycreeper (4,6)
16 Nutria (5)
18 Large bird of prey, genus *Bubo* (5,3)
21 Wetland habitat (3)
22 Slow-moving arboreal mammals (6)
26 Herbivorous New World lizard (6)
28 Bird's home (4)
29 Blunt-nosed rodent (4)
30 Songbird that might by sky, wood or short-toed (4)
31 Organs of vision (4)

August crossword

Across: 1 Cicely, 4 Starling, 10 Wolverine, 11 Costa, 12 Loach, 13 Corncrake, 14 Peewits, 16 Eyed, 19 Shag, 21 Cassava, 24 Horsetail, 25 Genet, 26 Broom, 27 Kinkajous, 28 Greenlet, 29 Maples

Down: 1 Cowslips, 2 Collared, 3 Leech, 5 The tree, 6 Rock cress, 7 Instar, 8 Grapes, 9 Circus, 15 Ichneumon, 17 Tawny owl, 18 Cactuses, 20 Grackle, 21 Colony, 22 The Bog, 23 Oriole, 25 Guava

SPOT THE DIFFERENCE



As its name suggests, the clouded ground gecko is a ground-dwelling lizard with prominent, blotch-like markings. The species is found in the forests of South India. Can you spot all five differences between the two images? Turn to page 96 to find the answers.

CROSSWORD SET BY RICHARD SMYTH. CLOUDED GROUND GECKO: EPHOTOCORP/ALAMY

Your LETTERS

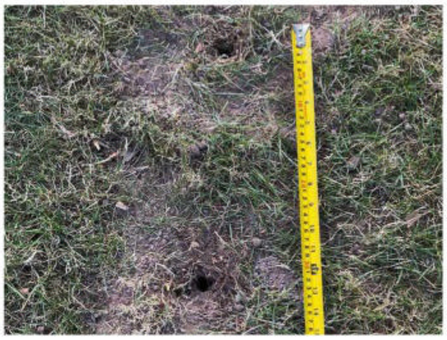
A male common picture wing dragonfly in India

Dragonfly dialogue

I started talking to dragonflies in India at a place where my husband and I stayed several times in the foothills of the Himalayas. I noticed that dragonflies came and settled in the sunshine on the paving outside our room. I decided to talk to one that was several feet away. After a few minutes it went up in the air and came down again a bit closer to me. This continued until it was next to me. Extraordinary. Considering dragonflies do not have ears, I suppose they feel some form of vibration.
Liz Kahn, via email

Badger foundation

I wanted to share with readers the sad news that Debbie Bailey, who developed and led the largest volunteer badger vaccination programme in the UK and made a huge contribution to ending the badger cull in Britain, died suddenly at the age of 58 on 1st August, leaving a huge hole in the world of badger and wildlife conservation. The Derbyshire badger vaccination project was groundbreaking and became influential at the highest levels in government, because it demonstrated that a real alternative to shooting badgers was possible. In 2018, in recognition of her work, Debbie was awarded the International Fund for Animal Welfare (IFAW) Animal Action Award. A foundation is being established in her name to continue her work (debbiebailey.org).
Sue Mayer, via email



The hole truth

These holes appeared in my lawn at the height of a prolonged dry spell. I put some sand around them hoping for footprints but there's been no sign, and my camera-trap has shown nothing at night so far. Any ideas?
John Molesworth, Weston-super-Mare

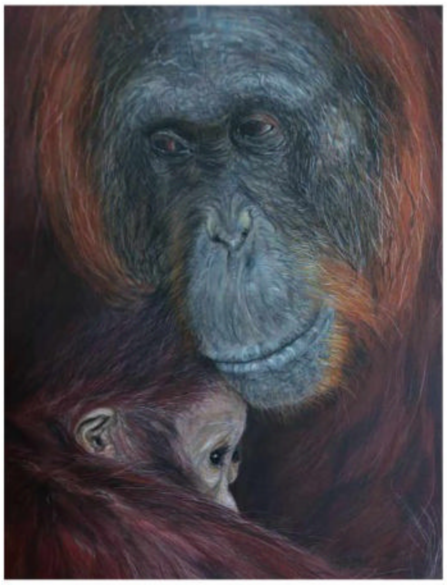
We passed this on to our columnist Kate Bradbury, an expert on wildlife gardening, who says: "These are most likely caused by voles, which make a network of shallow tunnels in lawns – both to feed on grass roots and bulbs, but also to breed. The holes don't cause too much damage, though a big network can lead to an uneven lawn surface. However, they are easy to fix with some topsoil and grass seed. If the holes are not in the way, why not leave them? Voles are great, and a bumblebee queen may choose one to found her nest in spring. Be nice to voles and save bumblebees. What's not to like?"

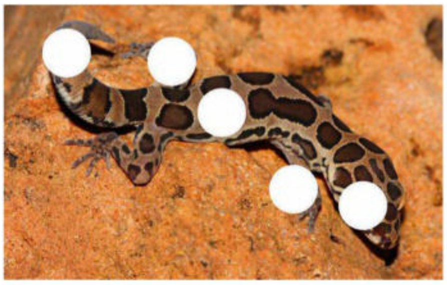
Horseshoe crabs

The life-saving properties of the horseshoe crab's blue blood do not represent a symbiotic relationship between our two species (Q&A, July issue). The crab is facing an existential threat from medical science in addition to the challenges of climate change, the fishing industry and pollution. Every year half-a-million are taken to labs to be bled and then returned to the ocean, after which there is about a 15 per cent mortality rate. How can any species sustain such losses?
Ian Pickford, Glasgow

Cover version

I recently took up pastel pencil drawing. I was so taken with the beautiful image of the orangutan mother and baby on your August cover, I thought I'd draw and share it.
Gareth Jones, via email





Answers to Spot the Difference on page 95

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BBC
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'Noctourism' brings a new dimension to wild travel, with spectacles such as glowing fireflies, here lighting up a forest in Japan

NEXT MONTH

Travel special

ON SALE
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By giving wildlife a value, tourism can protect habitats and support local communities. In our travel special, we showcase meaningful journeys that aid conservation, such as bear-watching in the Italian Apennines and raptor-tracking in Kenya's Masai Mara. We'll also sail down a rainforested river in Peru and share the thrill and magic of wildlife 'noctourism'. Don't miss it!

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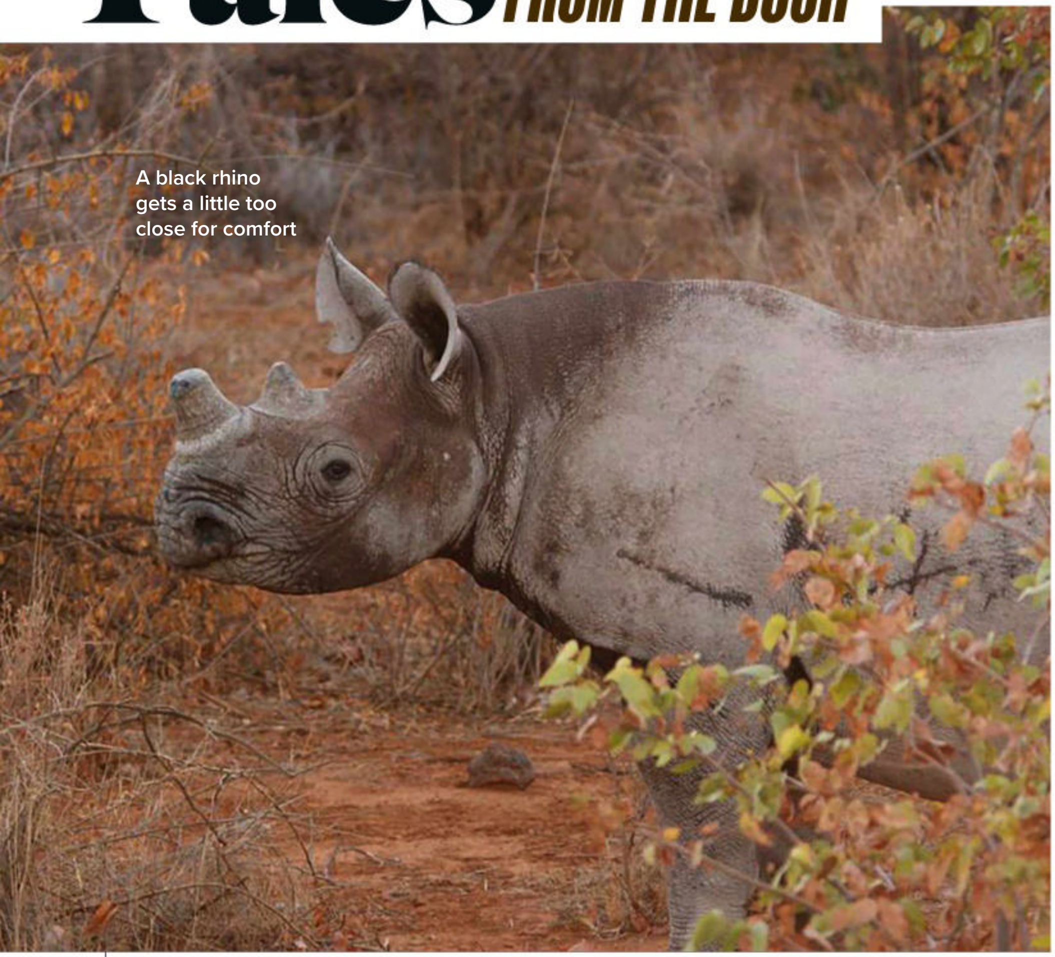
Tales FROM THE BUSH



A black rhino gets a little too close for comfort

“My only option was to pretend to be a tree”

Black rhinos in Namibia

BY JESS STEVENS

“LET ME INTRODUCE YOU TO 19-year-old me, back when I was doing my undergraduate degree in zoology and had a chance to work in the industry for a year. Most of my fellow students stayed relatively local but some of us chose to venture further afield. Pretty far afield, in my case: the middle of the Namibian bush, to conserve rhinos for the Rhino Momma Project.

There, my regular duties included patrolling the reserve to check camera-traps and search for signs of rhinos in the environment. One morning, I chanced upon some tracks leading into thick vegetation – too thick for my truck. This was black rhino territory, the more aggressive of the African rhinos, but they were hardly ever seen. So I decided to take a chance and follow the tracks on foot to see if they led to a water hole or evidence of mud-bath use.

Tracking conditions were perfect: the sun was ahead of me, casting shadows into every indent of the footprints, highlighting a captivating trail into the wilderness. It was an intimate insight into the life of this elusive animal. It was also blinding me, but I didn’t worry too much about that. Neither did I fret that the tracks were leading me deeper into the bush and further away from my truck.

Then, suddenly, while shimmying through some thorn bushes, I heard a huffing from somewhere close by. (Side note for anyone unfamiliar with the sounds of the savannah: a huffing or snorting noise is often indicative of an angry rhino.)

I stopped, my senses heightened. Looking around was fruitless – to the front, the blazing sunshine burned my retinas, and in every other direction my view was obscured by thick vegetation. I listened intently to the soundscape: guinea fowl, crickets, hornbills, an annoyed zebra somewhere in the distance. No huffing.

After a few minutes with no indications of a rhino present, I ventured forward, step by step, until I was stopped in my tracks by the startling sound of a loud huffing snort right in front of me. I looked intently into the sunlight, willing my eyes to take in every detail, and the huge shadow of an irate black rhino emerged from the glare about two metres from where I stood. Ahh…

I carried out a rapid assessment of my situation. My truck, armour-plated and capable of withstanding a rhino charge, was not an option. The closest high branches were too far away – the rhino would easily get to me first – and didn’t look particularly climbable, anyway. Running would be futile, as black rhinos can reach speeds of 55kph, much faster than my legs can carry me. My only option was to pretend to be a tree.

I stood stock-still and silent. I was struck by a sudden awareness of my body’s smallest movements: my leg swaying slightly from standing in an awkward position on the uneven ground, and my chest rising and falling with each inhale and exhale. Trees don’t tend to move like that. I calmed my breath and commanded every muscle in my body to remain as still as possible. My survival hung in the decision of this one animal: would it charge or retreat?

Seconds felt like minutes. Time dilated as a Mexican stand-off played out. The rhino stood frozen, staring me down, snorting its discontent. I knew they have poor eyesight but I was relying on this one having *exceptionally* poor eyesight.

In a moment, it was all over. The rhino turned and ran, disappearing into the bushes as if it had never been there. I released my breath, previously unaware I had been holding it, and walked away with a chuckle and an ever-increasing fondness and respect for nature’s wild animals. I went back to my truck, jumped in and continued my search for rhinos. Just another day in the African bush.

ABOUT THE AUTHOR

Jess currently works for the University of Cumbria as project officer for the South Cumbria Pine Marten Recovery Project.

BLACK RHINO: JESS STEVENS

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